Report No. FHWA-RD-76-163

HIGHWAY-VEHICLE-OBJECT SIMULATION MODEL--1976

Vol. 2. Programmers Manual

February 1976

Final Report

Prepared for

FEDERAL HIGHWAY ADMINISTRATION

Offices of Research & Development

Washington, D. C. 20590

NOTICE

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Technical Report Documentation Page

1. Report No.
FHWA-RD-76-163

2. Government Accession No.

3. Recipient's Catalog No.

4. Title and Subtitle
Highway-Vehicle-Object Simulation Model - 1976,
Programmers Manual

5. Report Date
February 1976

6. Performing Organization Code

7. Author(s)
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8. Performing Organization Report No.
ZR-5461-V-7

9. Performing Organization Name and Address
Calspan Corporation
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Buffalo, New York 14221

10. Work Unit No. (TRAIS)
FCP 31H2232

11. Contract or Grant No.
DOT-FH-11-8265

12. Sponsoring Agency Name and Address
U.S. Department of Transportation
Federal Highway Administration
Contracts and Procurement Division
Washington, D.C. 20590

13. Type of Report and Period Covered
Final Report
February 1974 -
February 1976

14. Sponsoring Agency Code
S0608

15. Supplementary Notes

FHWA Contract Manager: Morton S. Oskard

16. Abstract
A series of reports have been written to document revised and updated versions of the simulation of highway-vehicle-object interactions in a single vehicle highway environment. The programs documented were developed under FHWA sponsorship to provide the highway safety community with an analytical means of evaluating the effects of highway/roadside environment on safety.

This manual is addressed to the applications programmer who might wish to modify or extend the HVOSM. The detailed descriptions of the subroutines and linkages among them are designed to be used in conjunction with a source program listing. Ancillary information of interest to the programmer is also included.

This manual is one of four volumes.

Contractors Report No. ZR-5461-V	Short Title
-6	HVOSM - 1976 Users Manual
-7	HVOSM - 1976 Programmers Manual
-8	HVOSM - 1976 Engineering Manual - Analysis
-4	HVOSM - 1976 Engineering Manual - Validation

17. Key Words
HVOSM, Vehicle Dynamics
Computer Simulation

18. Distribution Statement
No restrictions. This report is available to the public through the National Technical Information Service, Springfield, Virginia, 22161.

19. Security Classif. (of this report)
Unclassified

20. Security Classif. (of this page)
Unclassified

21. No. of Pages
575

22. Price

FOREWORD

This report is one of four manuals prepared under Contract Number DOT-FH-11-8265 for the Federal Highway Administration, U.S. Department of Transportation for the purpose of summarizing and upgrading documentation of the Highway-Vehicle-Object Simulation Model (HVOSM). The HVOSM had been previously developed for the Federal Highway Administration (FHWA) by the Calspan Corporation (formerly Cornell Aeronautical Laboratory) under Contract Number CPR-11-3988 during the period from 1966 to 1971 and extended under this contract. Contained in this report is a description of the experimental validation procedures employed in determining the degree and range of validity of the HVOSM.

Complete documentation of the HVOSM is contained in the following manuals:

- Highway-Vehicle-Object Simulation Model
  Volume 1 - Users Manual
- Highway-Vehicle-Object Simulation Model
  Volume 2 - Programmers Manual
- Highway-Vehicle-Object Simulation Model
  Volume 3 - Engineering Manual - Analysis
- Highway-Vehicle-Object Simulation Model - Volume 4 - Engineering Manual - Validation

This report has been reviewed and is approved by:

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1. INTRODUCTION

In 1966 Calspan Corporation (formerly Cornell Aeronautical Laboratory, Inc.) began development of a general mathematical model and computer simulation of the dynamic responses of an automobile in accident situations under Contract CPR-11-3988 with the Bureau of Public Roads.

The mathematical model of vehicle dynamics developed in the first year of that effort included the general three-dimensional motion resulting from vehicle control inputs, traversal of irregular terrain, or from collisions with simple roadside barriers. The model was subsequently named the Highway-Vehicle-Object Simulation Model (HVOSM). Later, the model was further developed and a comprehensive validation program was carried out including a series of repeatable full-scale tests with an instrumented vehicle in order to objectively assess the degree of validity of the vehicle model. Extensive measurements of the vehicle parameters required for input to the HVOSM were made under a subcontract with the Ford Motor Company as a part of the validation procedure. This effort was reported in Reference 1 and the model as described therein has been referred to as the V-3 version of the HVOSM.

Modifications were subsequently made to the simulation in order to study the effects of terrain (specifically, railroad grade crossings) on vehicle control ability. The impact routines were removed and extended terrain definition capabilities were added along with a more realistic model of suspension properties. This program version (Reference 2) has been informally referred to as the V-4 version of the HVOSM and has since been used extensively for study of roadway and roadside geometrics.

Further developments of HVOSM aimed at providing a simulation model suitable for the study of the complex dynamics resulting from pre-collision evasive maneuvers were reported in Reference 3. This version, informally called the V-7 version of the HVOSM, includes a detailed model of the braking and driving systems and an empirically based definition of the relationships between longitudinal and lateral tire forces through the inclusion of rotational degrees of freedom of the four vehicle wheels.

During development of the HVOSM, documentation efforts primarily fulfilled the objectives of maintaining communication within the program development structure, ensuring quality control of the development and providing a historical reference. It was, however, recognized early in the development of the HVOSM, that this state-of-the-art advance in the modeling of a vehicle and its environment could be put to best use through its widespread distribution to organizations interested in its application to highway safety. As a result, distribution of the HVOSM was begun before its development was complete and before instructional documentation could be provided.

Recognizing the need to bring documentation of the several HVOSM versions together and to provide the highway safety community with an effective description of the programs and their use, the Federal Highway Administration (FHWA) awarded Calspan Corporation contract number DOT-FH-11-8265 for the purpose of providing such documentation for the then existing versions of the HVOSM.

Three versions of the HVOSM were covered by this documentation. They were, the HVOSM-SMI1 (Sprung Mass Impact) version (formerly known as the V-3 version), the HVOSM-RD1 (Road Design) version (formerly known as the V-4 version) and the HVOSM-VD1 (Vehicle Dynamics) version (formerly known as the V-7 version). Under the first phase of that effort, only those versions as developed by Calspan were covered by the documentation.

The second phase of contract number DOT-FH-11-8265 called for extension of the capabilities of the HVOSM by adding new features, including some additional modifications made by other research organizations, and providing additional ease of use features.

Accordingly, Calspan has:

- Generalized the basic vehicle model to include the capability for simulating an independent front and rear suspension vehicle and a vehicle with solid front and rear axles.

- Generalized the tire model to allow specification of up to four different tires on a vehicle and revised the friction ellipse tire model.

- Combined the sprung mass impact version with the roadside design version resulting in only two program versions at the end of the second phase.

- Incorporated the Preview-Predictor Driver Model described in Reference 4 into the vehicle dynamics model.

- Incorporated impact forces due to localized structural hard points into the sprung mass impact algorithm. This modification was originally developed by the Texas Transportation Institute (TTI) and was added as reported in Reference 5.

- Extended the curb impact algorithm to allow up to six planes to describe a curb. This modification was also developed by TTI and was reported in Reference 6.

- Developed a road roughness algorithm to allow determination of the effects of road roughness on vehicle performance.

- Revised imput and output format to provide an easy to use, more flexible data interface.

- Developed a Pre-Processing Program to calculate a number of program inputs including vehicle and terrain data or to supply input cards from a stored library of vehicle data.

The documentation provided now covers the two program versions: the HVOSM-RD2 Version (Roadside Design) and the HVOSM-VD2 Version (Vehicle Dynamics). It is intended to be a base to which further developments and modifications to the HVOSM can be added, thus providing a uniform reporting format and centralized source of information for the many HVOSM users. It consists of four volumes, each describing a separate aspect of the HVOSM. Two volumes are directed toward the engineer/analyst containing the analysis (derivation of governing equations, assumptions, and development of controling logic) and experimental validation. Another volume is directed toward the general program user and contains analysis/program symbology, descriptions of the models and solution procedures, descriptions of input requirements and program application examples. The fourth volume of documentation is intended for use by those interested in the detailed computer programs. This volume contains descriptions of the computer code including a discussion of subroutine functions, annotated flowcharts and program listings. Also included are a list of program changes, a description of program stops and messages, and computer system requirements necessary to run the programs.

This report contains detailed descriptions of the three HVOSM computer programs. Symbology is defined in Section 2. Section 3 contains detailed descriptions of the programs including subroutine functions, flowcharts, listings, messages and codes, and program changes. Section 4 contains system requirements for execution of the programs, a listing of the HVOSM Preprocessing program is given in Section 5, and references are contained in Section 6.

2. SYMBOLOGY

The HVOSM symbology is presented in this section with a cross-reference between analytical and programming symbols. The first listing of symbols is ordered with respect to analytical symbol and includes a corresponding program symbol, a brief definition and an equation number referencing the calculation of the variable in the "HVOSM Engineering Manual - Analysis". Input variables are indicated by an I in the equation number column.

The second listing of variables is organized by program symbol name and includes a corresponding analytical variable or expression and variable usage in each program version. The codes U and A under the program version name indicate that the variable is used or appears, but is not used respectively in that version.

ANALYTICAL SYMBOL	PROGRAM SYMBOL	EQN NO	DEFINITION	UNITS
a	A	I	Distance along vehicle fixed x axis from the sprung mass center of gravity to the center line of the front wheels	in.
a_i, b_i, c_i		155	Directional components of a line perpendicular to both the normal to the wheel plane and the radial tire force, F_{R_i}	
APD APDMAX	APD APDMAX	345 I	Accelerator pedal deflection and maximum accelerator pedal deflection	in
$a_{s_i}, b_{s_i}, c_{s_i}$	AS(4) BS(4) CS(4)	258	Directional components of a line perpendicular to both a normal to the tire-terrain contact plane and the line of intersection of the wheel and ground planes	
$a_{x_i}, b_{x_i}, c_{x_i}$	AX(4) BX(4) CX(4)	99	Direction components of a line perpendicular to both a normal to the tire-terrain contact plane and the vehicle fixed y axis	
$a_{y_i}, b_{y_i}, c_{y_i}$	AY(4) BY(4) CY(4)	104	Direction component of a line perpendicular to both a normal to the tire-terrain contact plane and the vehicle fixed x axis	
[A]	AMTX(3,3)	53	Transformation matrix from vehicle fixed to space fixed coordinate systems	
$(A_{INT})_i$	AINTI	287	Intersection area of cutting plane i with the sprung mass	in^2
$[A_j]$	AJMTX(3,3)	134	Transformation matrix from wheel fixed to vehicle fixed coordinate systems	
AMU	AMU	I	Tire-terrain friction coefficient at zero speed and nominal tire loading	
AMUG	AMUG(5)	I	Tire-terrain friction coefficient factor for 5 terrain tables	
$(AP)_F$	APF(21)	I	Anti-pitch coefficients for front suspension positive for anti-pitch for forward braking	lb/lb-ft
$(AP)_R$	APR(21)	I	Anti-pitch coefficients for rear suspension, effective at the wheels; positive for anti-pitch effect for forward braking	lb/lb-ft

ANALYTICAL SYMBOL	PROGRAM SYMBOL	EQN NO.	DEFINITION	UNITS
$(AR)_j$	ARBRF ARBRR	I	Drive axle ratio (propeller shaft speed/wheel speed). Default of 1.0	
A_0, A_1, A_2	A0,A1,A2	I	Constant coefficients for tire side force due to slip angle	
A_3, A_4	A3,A4	I	Constant coefficients for tire side force due to camber angle	
b	B	I	Distance along the vehicle fixed x axis from the sprung mass center of gravity to the centerline of the rear wheels (entered positive)	in.
[B]	BMTX(3,3)	134	Transformation matrix from wheel fixed to space fixed coordinate systems	
B_{FP1} B_{FP2}	BFP1 BFP2	I	First and second order coefficients for relationship between brake pedal force and brake system pressure	psi/lb psi/lb^2
$[B_n]$	BNMTX(3,3)	60	Transformation matrix from orientation of vehicle axes at indexing to space fixed axes (Euler angles= $\psi_n', \theta_n', \phi_n'$)	
C_{co}		215	Small angle camber stiffness	lb/rad
C_F, C_R	CF CR	I	Front and rear viscous damping coefficient for a single wheel, effective at the wheel for the front and at the spring at the rear	lb-sec/in
C'_F, C'_R	CFP CRP	I	Front and rear coulomb damping for a single wheel, effective at the wheel for the front and at spring for the rear	lb
$[C_i]$	CMTX(3,4)	110	Coefficient matrix for simultaneous solution of the ground contact point	
$\overline{CONS}$	CONS	I	Ratio of conserved energy to total energy absorbed by the sprung mass	
$[C_n]$	CNMTX(3,3)	60	Transformation matrix from vehicle fixed axes to most recently indexed axes (Euler angles= $\psi_t', \theta_t', \phi_t$)	
C_{RRMi}	RRMC(4)	I	Rolling resistance moment coefficient	lb-in/lb
C_{So}		214	Small angle cornering stiffness	lb/rad
(CT)	TCT(12)	I	Closed throttle engine torque	lb-ft

ANALYTICAL SYMBOL	PROGRAM SYMBOL	EQN NO.	DEFINITION	UNITS
C_{Ti}	CT(4)	I	Circumferential tire force stiffness	lb
C'_ψ	CPSP	I	Coulomb resistance torque in the steering system effective at the wheels	lb-in
C_1, C_2, C_3	CONE CTWO CTHREE	I	Coefficients in relationship approximating aerodynamic and rolling resistance	
[D]	DMTX(10,11)	46	Mass matrix of coupled second order differential equations. Column 11 contains the forcing functions	
Dax	DELTAX	342	Desired vehicle acceleration	in/sec^2
DELB DELE DDEL	DELB DELE DDEL	I I I	Beginning, end, and incremental wheel deflection for entered front wheel camber table	in
DIST	DIST	I	Desired speed differential nulling distance	in
DRWHJ	DRWHJ	I	Incremental tire deflection for calculation of the equivalent tire force-deflection characteristic in the radial mode	in
D_{1i}, D_{2i}, D_{3i}	D1(4) D2(4) D3(4)	87	Direction components of a line perpendicular to the normals of both the wheel plane and the tire-terrain contact plane	
e_i	EI	320	Error between predicted and desired path at the ith viewing position	in
EN	EN	I	Number of points at which e_i is determined	
F_{APi}	APITCH	188	Anti-pitch force at wheel i	lb
F_{ARi}		187	Force at wheel i due to auxiliary roll stiffness	lb
F_B	FB		Resistance force normal to the contact surface of a deformable barrier	lb
FBRK	FBRK	346	Brake pedal force	lb
F_{c_i}	FC(4)	225	Circumferential tire force	lb
Fcxui Fcyui Fczui	FCXU(4) FCYU(4) FCZU(4)	254	Components of the circumferential tire force along the x,y, and z axes	lb
F_j	FJP(35)	144	Table of equivalent radial spring forces as a function of deflection	lb
F_{JFi}	FJF(4)	179	Jacking force at wheel i	lb
$(Fn)_t$	FN	298	Vehicle force produced by deformation of the vehicle structure normal to the contacted surface	lb

ANALYTICAL SYMBOL	PROGRAM SYMBOL	EQN NO.	DEFINITION	UNITS
F_{NSTi}	FNSTI(3)	300	Structural hard point force	lb
F_{R_i}	FR(4)	114	Radial tire force in the plane of the wheel	lb
F'_{Ri}	FRCP(4)	212	Tire force perpendicular to the tire-terrain contact plane	lb
(FRICT)	FRICT	306	Friction force acting between the vehicle sprung mass and barrier	lb
F_{Rxui} F_{Ryui} FRzui	FRXU(4) FRYU(4) FRZU(4)	253	Components of F'_{Ri} along the sprung mass axes for wheel i	lb
$\Sigma F_{Rx'i}$ $\Sigma F_{Ry'i}$ $\Sigma F_{Rz'i}$	SFRX(4) SFRY(4) SFRZ(4)	144 145 146	Summation of the components of radial spring mode forces over tire i, with respect to space	lb
F_{Si}	FS(4)	227	Tire side force in the plane of the tire-terrain contact patch perpendicular to the line of intersection of the wheel plane and ground plane	lb
F'_{Si}		220	Resultant side force corresponding to small angle properties for slip and camber angles	lb
$(F_{si})_{max}$		224	Maximum achievable side force as limited by the available friction	lb
ΣF_{xs}	SFXS	307 351	Sprung mass impact force or combination of rolling resistance and aerodynamic drag acting along the vehicle x axis	lb
Fsxui Fsyui Fszui	FSXU(4) FSYU(4) FSZU(4)	256	Components of tire side force, F_{si} along the sprung mass axes	lb
Fxui Fyui Fzui	FXU(4) FYU(4) FZU(4)	259 260 261	Total tire force components along the vehicle axes	lb
Σ Fxu Σ Fyu	SFXU SFYU	353 354	Resultant forces acting on the vehicle through the unsprung masses in the x and y directions	lb
Σ Fys	SFYS	307	Sprung mass impact force acting along the vehicle y axis	lb
Σ Fzs	SFZS	307	Sprung mass impact force acting along the vehicle z axis	lb
ΣF_{Z1}	SFZ1	356	Resultant force transmitted through the suspensions in the z direction	lb
F_{1Fi} F_{1Ri}	F1FI(2) F1RI(2)	174 184	Front and rear suspension coulomb damping forces for a wheel, effective at the wheel for the front and at the spring for the rear	lb

ANALYTICAL SYMBOL	PROGRAM SYMBOL	EQN NO	DEFINITION	UNITS
F_{2Fi} F_{2Ri}	F2FI(2) F2RI(2)	175 185	Front and rear suspension spring and bumper forces for a wheel, effective at the wheel for the front and at the spring for the rear	lb
g	G	I	Acceleration due to gravity	in/sec^2
$GEAR_1$ $GEAR_2$ $GEAR_3$ $GEAR_4$	GEAR1 GEAR2 GEAR3 GEAR4	I	Transmission gear ratios	—
G_{1j}	GN(1,J)	I	Lever arm lengths in brake types 1,2 and 3	in
G_{2j}	GN(2,J)	I	Brake actuation constant, assumed to be equal for both shoes of brake types 1 and 2	
G_{3j}	GN(3,J)	I	Effective lining-to-drum or lining to-disk friction coefficient at design temperature for all shoes or disks in types 1,2 and 4 and for the primary shoe of type 3	
G_{4j}	GN(4,J)	I	Cylinder area for actuation of leading shoe of brake type 1, or for each shoe in types 2 and 3. Also used for total cylinder area per side of disk in type 4	in^2
G_{5j}	GN(5,J)	I	Cylinder area for actuation of trailing shoe of brake Type 1	in^2
G_{6j}-G_{11j}	GN(6,J)- GN(11,J)	I	Brake dimensions for type 3.	in
G_{12j}	GN(12,J)	I	Effective lining to drum friction coefficient for secondary shoe of brake type 3	
G_{13J}	GN(13,J)	I	Mean lining radius for brake type 4	in
G_{14j}	GN(14,J)	I	Coefficient of heat transfer for convective losses	
G_{15j}	GN(15,J)	I	Specific heat of brake assembly	BTU/lb/°F
G_{16j}	GN(16,J)	I	Effective weight of brake assembly for heat absorption	lb
h_i	HI(4)		Tire rolling radius	in
I_{Dj}	FIDJ(2)	I	Driveline inertia for front or rear (Note that a value of zero is entered at the non-driving end of the vehicle)	lb-sec^2-in

ANALYTICAL SYMBOL	PROGRAM SYMBOL	EQN NO	DEFINITION	UNITS
I_R	XIR	I	Rear unsprung mass moment of inertia about a line through its center of gravity and parallel to the vehicle x axis	lb-sec^2-in
I_{wj}	FIWJ(4)	I	Rotational inertia of an individual wheel at the front or rear	lb-sec^2-in
Ix,Iy,Iz	XIX XIY XIZ	I	Spring mass moments of inertia about the vehicle axes	lb-sec^2-in
Ixz	XIXZ	I	Spring mass roll-yaw product of inertia	lb-sec^2-in
(I'x)t		47	Effective inertial term due to time varying positions of the unspring masses	
(I'z)t		47	Effective inertial term due to time varying positions of the unspring masses	
(I'xz)t		47	Effective inertial term due to time varying positions of the unspring masses	
(I'yz)t		47	Effective inertia term due to time varying positions of the unspring masses	
I_ψ	XIPS	I	Moment of inertia of the steering system effective at the front wheels (includes both wheels)	lb-sec^2-in
K_d	FKD	I	Performance parameter characterizing understeer/oversteer properties of the vehicle	sec^2/in
K_F,K_R	AKF AKR	I	Front and rear suspension load deflection rate in the quasi-linear range about the design position effective at the front wheels and the rear springs	lb/in
K_{FC},K_{RC}	AKFC AKRC	I	Coefficients for the compression bumpers of the front and rear suspension effective at the front wheels and rear springs	
K'_{FC}, K'_{RC}	AKFCP AKRCP	I	Coefficients for the cubic terms of the suspension compression bumpers	
K_{FE},K_{RE}	AKFF AKRE	I	Coefficients for the extension bumpers of the front and rear suspension effective at the front wheels and rear springs	

ANALYTICAL SYMBOL	PROGRAM SYMBOL	EQN NO.	DEFINITION	UNITS
K'_{FE}, K'_{RE}	AKFEP AKREP	I	Coefficients for the cubic terms of the suspension extension bumpers	
K_P	FKP	328	Driver steer control gain	
K_{RS}	AKRS	I	Rear axle roll-steer coefficient, positive for roll understeer	
K_{S1}, K_{S2}	FKS1 FKS2	I	Drivers estimate of vehicle braking and accelerating gains	
K_{STi}	AKST(3)	I	Structural hard point spring rates	lb/in
K_T	AKT	I	Radial tire rate in the quasi-linear range	lb/in
K_V	AKV	I	Load-deflection characteristic of the vehicle structure	lb/in^3
$K_{\delta S}, K_{\delta S1}, K_{\delta S2}, K_{\delta S3}$	AKDS AKDS1 AKDS2 AKDS3	I	Coefficients of the cubic representation of rear wheel steer as a function of deflection for independent rear suspension	
K_{ψ}	AKPS	I	Load-deflection rate for the linear steering stop, effective at the wheels	lb-in/rad
K_1	AK1	I	Slope of P_R vs P_F for values of P_F between P_1 and P_2	
K_2	AK2	I	Slope of P_R vs P_F for values of P_F greater than P_2	
$(LF)_i$	FLF	I	Fade coefficient for brake at wheel i	
M_S	XMS	I	Sprung mass	$lbsec^2/in$
M_{UF}, M_{UR}	XMUF XMUF	I	Front (both sides) and rear unsprung masses. Note $M_1=M_2=M_{UF}/2$, $M_3=M_{UR}$	$lbsec^2/in$
M_1, M_2	$\frac{XMUF}{2}$		Right and left front unsprung masses	$lbsec^2/in$
M_3	XMUR	I	Rear unsprung mass	$lbsec^2/in$
NBX	NBX(5)	I	Number of x' boundaries supplied for 5 terrain tables	
NBY	NBY(5)	I	Number of y' boundaries supplied for 5 terrain tables	
NDEL	NDEL		Number of entries in the front wheel camber table	
NX	NX(5)		Number of x' grid points in 5 terrain tables	
NY	NY(5)		Number of y' grid points in 5 terrain tables	
NZTAB	NZTAB	I	Number of terrain tables entered	

ANALYTICAL SYMBOL	PROGRAM SYMBOL	EQN NO.	DEFINITION	UNITS
P_1, P_2	PONE PTWO	I	"Break" pressures for brake system proportioning valve	psig
$(RATIO)_i$			Factor used to modify the nominal tire-terrain friction coefficient at wheel i to reflect the effects of vehicle speed and tire loading	
R_{BB}	RBB	280	Constant for barrier bottom plane	in
R_{Bi}	RBI	269	Constant for barrier face plane	in
R_{BT}	RBT	281	Constant for barrier top plane	in
R_{B_1}	RB1	273	Constant for the plane perpendicular to the barrier face plane and containing the axis of rotation	in
NZ5	NZ5	I	Flag to indicate whether the variable increment terrain table is supplied, =0,no,≠0, yes	
$\Sigma N_{\phi F}$	SNPF	367	Roll moment acting on the front axle	lb-in
$\Sigma N_{\phi R}$	SNPR	360	Roll moment acting on the rear axle	lb-in
$\Sigma N_{\phi S}$	SNPS	308	Roll moment on the sprung mass resulting from sprung mass impact forces	lb-in
$\Sigma N_{\theta S}$	SNTS	309	Pitch moment on the sprung mass resulting from sprung mass impact forces	lb-in
$\Sigma N_{\psi S}$	SNPSS	310	Yaw moment on the sprung mass resulting from sprung mass impact forces	lb-in
$\Sigma N_{\phi U}$ $\Sigma N_{\theta U}$ $\Sigma N_{\psi U}$	SNPU SNTU SNPSU	357 358 359	Moments acting on the sprung mass produced by forces acting on the unsprung masses	lb-in
P,Q,R	P,Q,R	+8	Scalar components of the sprung mass angular velocity along the vehicle x,y and z axes	rad/sec
P_C	PC	I	Hydraulic pressure in brake system master cylinder	psig
P_j	PP(2)	197	Hydraulic pressure in brake cylinders at front or rear brakes	psig
(PS)			Prop shaft speed	rpm

ANALYTICAL SYMBOL	PROGRAM SYMBOL	EQN NO.	DEFINITION	UNITS
(PT)	XPS	I	Pneumatic trail of front tires	in
R_F, R_R	RF,RR	I	Auxiliary roll stiffness of the front and rear suspensions	lb/in/rad
(RPME)	RPME	211	Engine speed	rpm
$(RPS)_i$	RPSI(4)	44	Rotational velocity of wheel i, positive for forward motion of the vehicle	rad/sec
R_{RMi}	RRM(4)	352	Rolling resistance moment acting on wheel i	lb-in
R_W	RW	I	Undeflected tire radius	in
RWHJB RWHJE	RWHJB RWHJE	I	Beginning and ending radii for calculation of the radial tire force-deflection characteristic used in the radial tire mode	in
SET	SET	I	Ratio of permanent deflection to maximum deflection of deformable barrier	
S_i	SI(4)	173 183	Total suspension force for a wheel, acting at the front wheels and rear springs	lb
$(SLIP)_i$	SLIP(I)	241	The amount by which the rotational speed of wheel i is less than that of free rotation expressed as a decimal portion of the speed of free rotation	
$(SLIP)_{pi}$	SLIPP	198	The value of (SLIP)i, at a given wheel center speed U_{Gi} for which the value of μ_{x_i} is a maximum	
SP_n	ST(5,2)	I	Coefficients for straight line segments defining the desired path	
$(S_1)_i$, $(S_2)_i$, $(S_3)_i$	S1I S2I S3I	284 285 286	Characteristic lengths of intersection area between the sprung mass and barrier	in
t	T		Time	sec
T_b	TESTB	I	Braking indifference level	in/sec
T_B, T_E TINCR	TB,TE TINCR	I	Beginning, ending and incremental times for entry of control tables $(TQ)_F$, $(TQ)_R$ and ψ_F	sec
T_F, T_R	TF,TR	I	Front and rear track	in
T_i	TI(4)	225	Circumferential tire force resulting from applied torque	lb
T_I, T_L	TIL TL	I	Driver steering model lag and lead times	sec
$(TQ)_{Bi}$	TQB(4)	204	Brake torque at wheel i	lb-ft
$(TQ)_{Dj}$	TQD(4)	211	Drive line torque at prop shaft at vehicle end j	lb-ft
$(TQ)_E$	TQE	210	Engine torque	lb-ft
$(\overline{TQ})_F, (\overline{TQ})_R$	TQF(50) TQR(50)	I	Front and rear torque tables for a single wheel and effective at the wheel (positive for traction, negative for braking)	lb-ft
(TR)	TTTR	I	Transmission ratio (speed ratio of engine to prop shaft)	
T_{R_1}, T_{R_2}	TESTR1 TESTR2	I	Lower and upper skid thresholds	
T_S	TS	I	Distance between spring mounts for a solid rear axle	in
T_{SF}	TSF	I	Distance between spring mounts for a solid front axle	in
(TS)	TTTS	I	Throttle setting expressed as the decimal portion of wide open throttle	
T_{S1}, T_{S2}	TESTS1 TESTS2	I	Driver threshold/indifference levels for positive and negative speed errors	in/sec
(TYPE)	NBTYPE	I	Brake type indicator	
$T_{1\psi}$	T1PSI	36	Coulomb friction torque in steering system effective at the wheel	lb-in
$T_{2\psi}$	T2PSI	36	Resistance torque produced by the front wheel steer stops, effective at the wheel	lb-in
u,v,w	U,V,W	48	Scalar components of linear velocity of the sprung mass along the sprung mass x,y and z axes	in/sec
u',v',w'	DXCP DYCP DZCP	64	Scalar components of linear velocity of the sprung mass along the space fixed x',y' and z' axes	in/sec
u_i, v_i, w_i	UI(4) VI(4) WI(4)	90-98	Scalar components of the tire contact points linear velocity along the vehicle axes	in/sec
U_{Gi}	UG(4)	103	Wheel center forward velocity in direction parallel to the tire-terrain contact plane	in/sec
U_{Gwi}	UGW(4)	195	Ground contact point velocity along the circumferential direction of the wheel	in/sec
u'_n, v'_n, w'_n	UNP(17) VNP(17) WNP(17)	282	Components of the velocity of the three or four points that define the intersection area of the barrier and vehicle along the space-fixed axes	in/sec

ANALYTICAL SYMBOL	PROGRAM SYMBOL	EQN NO.	DEFINITION	UNITS
u'_r, v'_r, w'_r	URP, VRP, WRP	303	Components of the velocity of the point of application of the sprung mass impact force along the space-fixed axes	in/sec
U'_{STi}, V'_{STi}, W'_{STi}	UPT(4), VPT(4), WPT(4)	299	Components of the velocity of the deformed structural hard points along the space fixed axes	in/sec
U_T	UT	313	Total vehicle velocity	in/sec
V_{Gi}	VG(4)	106	Contact point lateral velocity in the direction parallel to the tire-terrain contact plane	in/sec
VGR_{12}, VGR_{21}, VGR_{23}, VGR_{32}, VGR_{34}, VGR_{43}	VGR12, VGR21, VGR23, VGR32, VGR34, VGR43	I	Vehicle speed at which transmission upshifts and downshifts occur	mph
(VTAN)	VTAN	305	Tangential velocity between the vehicle and barrier	in/sec
WE_i	WEIGHT(I)	328	Driver steering error weighting function	
WI_i	XIMPOR(I)	I	Driver steering error importance weighting function	
(WOT)	TWOT		Wide open throttle torque	lb-ft
X_B, X_E, XINCR	XB(5), XE(5), XINCR(5)	I	Beginning, ending and incremental x' for terrain tables	in
x_{BB}, y_{BB}, z_{BB}	XBB, YBB, ZBB	279	Coordinates of the intersection of the z' axis with the barrier bottom plane in the vehicle axes	in
X_{BDRY}	XBDRY(4,5)	I	x' intercept for angled boundaries within terrain tables	in
x_{Bi}, y_{Bi}, z_{Bi}	XBI, YBI, ZBI	267	Coordinates of the intersection of the y' axis with cutting plane i, in the vehicle axes	in
x_{BT}, y_{BT}, z_{BT}	XBT, YBT, ZBT	278	Coordinates of the intersection with the barrier top plane in the vehicle axes	in
X'_c, Y'_c, Z'_c	XCP, YCP, ZCP	65, 66, 67	Coordinates of the origin of the vehicle axes (sprung mass center of gravity) with respect to the space fixed axes	in
x_{cpn}, y_{cpn}, z_{cpn}	XCPN(3), YCPN(3), ZCPN(3)	214	Coordinates of the vehicle corner n in the vehicle axes	in
x'_{cpn}, y'_{cpn}, z'_{cpn}	XCPNP(3), YCPNP(3), ZCPNP(3)	214	Coordinates of the vehicle corner n in the space-fixed axes	in
X'_{GPi}, Y'_{GPi}, Z'_{GPi}	XGPP(4), YGPP(4), ZGPP(4)	150, 151	Coordinates of the ground contact points with respect to the space-fixed axes	in
X'_i, Y'_i, Z'_i	XP(4), YP(4), ZP(4)	68-82	Coordinates of the wheel centers with respect to the space fixed axes	in
x_n, y_n, z_n	XNN(17), YNN(17), ZNN(17)	276	Coordinates of intercept points between the barrier and sprung mass in the vehicle axes	in
X'_{Pi}, Y'_{Pi}	X, Y	318	Coordinates of the location on the desired path at which the ith error is determined	in
x_{Ri}, y_{Ri}, z_{Ri}	XRI, YRI, ZRI	294	Coordinates of the centroid of the intersection area on cutting plane i, projected on to the actual vehicle barrier interface of the previous time increment	in
$(\Sigma x_R)_t$, $(\Sigma y_R)_t$, $(\Sigma z_R)_t$	SXR, SYR, SZR	295, 296, 297	Coordinates of the point of application of the sprung mass impact force	in
x_{STi}, y_{STi}, z_{STi}	XSTI(3), YSTI(3), ZSTI(3)	301	Coordinates of the deformed structural hard points in the vehicle axes	in
x_{STi_o}, y_{STi_o}, z_{STi_o}	XSTIO(3), YSTIO(3), ZSTIO(3)	I	Coordinates of the underformed structural hard points in the vehicle axes	in
x_{VF}	XVF	I	Distance from the sprung mass c.g. to the vehicle front along the x axis	in
x_{VR}	XVR	I	Distance from the sprung mass c.g. to the vehicle rear along the x axis	in
X'_{VP_i}, Y'_{VP_i}	XVP, YVP	312, 313	Driver prediction of vehicle location at the ith sample increment in the future	in
X_1, Y_1, Z_1, X_2, Y_2, Z_2	X1,Y1,Z1, X2,Y2,Z2	I	Coordinates of accelerometer positions with respect to the vehicle axes for which acceleration components are output	in
$\{y\}$	VAR		System dependent variable, integral of $\{\dot{y}\}$	
$\{\dot{y}\}$	DER	47	First derivatives with respect to time of the system dependent variables	
Y_B Y_E, YINCR	YB(5), YE(5), YINCR(5)	I	Beginning, ending and incremental y' for terrain tables	in
Y_{BDRY}	YBDRY(4,5)	I	Lateral position of y' terrain boundaries with respect to space	in
y'_B	YBP	I	Lateral position of the barrier face plane with respect to space	in
y'_{C1}, y'_{C2}, y'_{C3}, y'_{C4}, y'_{C5}, y'_{C6}	YC1P, YC2P, YC3P, YC4P, YC5P, YC6P	I	Lateral positions of slope changes defining a curb	in
y_v	YV	I	Distance from the sprung mass c.g. to the vehicle side	in
z'_{BB}	ZBBP	I	Elevation of the bottom barrier plane in space	in

ANALYTICAL SYMBOL	PROGRAM SYMBOL	EQN NO.	DEFINITION	UNITS
Z'_{BT}	ZBTP	I	Elevation of the top barrier plane in space	in
Z'_{C2}, Z'_{C3}	ZC2P	I	Elevation of curb at slope$_{C2}$	in
Z'_{C4}, Z'_{C5} Z'_{C6}	ZC3P ZC4P ZC5P ZC6P	I	Change lateral positions	
Z_F	ZF	I	Static distance along z axis between the sprung mass center of gravity and the center of gravity of the front unsprung masses	in
$\bar{Z}'_G$	ZGP(21,21,5)	I	Input elevations of the terrain table grid points	in
Z'_{Gi}	ZPGI(4)	126	Ground elevation with respect to the space axes of the point beneath the wheel centers	in
Z'_{Gi}			A vector through the ground contact point normal to the actual or equivalent ground contact plane	
Z_R	ZR	I	Static distance along the z axis between the sprung mass center of gravity and the rear axle roll center	in
Z_{VB}	ZBV	I	Distance from the sprung mass c.g. to the plane defining the bottom of the vehicle along the z axis	in
Z_{VT}	ZVT	I	Distance from the sprung mass c.g. to the plane defining the top of the vehicle, along the z axis	in
$\alpha_B, \beta_B, \gamma_B$		266	Direction angles of a normal to the barrier face plane in the vehicle axes	
$\alpha_{BT}, \beta_{BT}, \gamma_{BT}$		277	Direction angles of a normal to the barrier top plane in the vehicle axes	
$\alpha_{B1}, \beta_{B1}, \gamma_{B1}$		273	Direction angles of a normal to the plane perpendicular to the barrier face plane and containing the axis of rotation	

ANALYTICAL SYMBOL	PROGRAM SYMBOL	EQN NO.	DEFINITION	UNITS
$\alpha_{ci}, \beta_{ci}, \gamma_{ci}$		255	Direction angles of a line perpendicular to the normals of both the wheel plane and tire-terrain contact plane with respect to space	rad
$\alpha_{GZ_i}, \beta_{GZ_i}, \gamma_{GZ_i}$		84	Direction angles of a normal to the tire-terrain contact plane at wheel i with respect to space	rad
$\alpha_{\ell i}, \beta_{\ell i}, \gamma_{\ell i}$		116	Direction angles of the resultant radial force on wheel i with respect to the vehicle axes	rad
$\alpha_j, \beta_j, \gamma_j$		143	Direction angles of a line from wheel center i to the ground contact point of tire radial spring j with respect to the vehicle axes	
$\alpha_{Ri}, \beta_{Ri}, \gamma_{Ri}$		148	Direction angles of the resultant radial force on wheel i with respect to the space axes	rad
$\alpha_{s_i}, \beta_{s_i}, \gamma_{s_i}$		257	Direction angles of a line perpendicular to both a normal to the tire-terrain contact plane and the wheel axis with respect to space	rad
$\alpha_x, \beta_x, \gamma_x$		102	Direction angles of the x axis with respect to space	
$\alpha_y, \beta_y, \gamma_y$		100	Direction angles of the y axis with respect to space	
$\alpha_{yw_i}, \beta_{yw_i}, \gamma_{yw_i}$		85	Direction angles of a normal to the wheel i with respect to space	
$\alpha_{w_i}, \beta_{w_i}, \gamma_{w_i}$		88	Direction angles of kingpin axis of wheel i	
β_i			Slip angle at wheel i	rad
β'_i	BETP(4)	219	Equivalent slip angle produced by camber of wheel i	rad
$\bar{\beta}_i$	BETBR(4)	223	Non dimensional slip angle variable for wheel i	
γ_1	GAM1	47	Inertial expressions	
$(\gamma_2)_t$	GAM2			
$(\gamma_3)_t$	GAM3			

ANALYTICAL SYMBOL	PROGRAM SYMBOL	EQN NO.	DEFINITION	UNITS
$(\tau_4)_t$	GAM4		Inertial expressions	
$(\tau_5)_t$	GAM5	47		
$(\tau_6)_t$	GAM6			
$(\tau_7)_t$	GAM7			
$(\tau_8)_t$	GAM8			
$(\tau_9)_t$	GAM9			
	DELBB		Barrier deflection	in
δ_1	DEL1		Right front suspension deflection for independent front suspension or front axle roll center deflection relative to the vehicle from position of statis equilibrium	in
δ_2	DEL2		Left front suspension deflection relative to the vehicle from static equilibrium position	in
δ_3	DEL3		Right rear suspension deflection for independent rear suspension or rear axle roll center deflection relative to the vehicle from static equilibrium position	in
δ_4	DEL4		Left rear suspension deflection relative to the vehicle from static equilibrium position	in
Δ_G	DELG	I	Distance between road roughness input points	in
Δ_i	DELTA(4)	112	Distance between the wheel center and ground contact point	in
Δt	DT	I	Numerical integration step interval	sec
Δt_B	DELTB	I	Time increment for use during barrier impacts	sec
Δt	DELTC	I	Numerical integration step size for curb impact option	sec
Δt_n	DTR		Integration step size for use with wheel spin equations of motion	sec
ΔT_{HFi} ΔT_{HRi}	DTHF1 DTHF2 DTHR3 DTHR4	I	Front and rear half-track changes with suspension deflection	in
$\Delta y'_B$	DELYBP	I	Incremental deflection of the barrier position	in
$\Delta\psi_{Fj}$	DPSILF	328	Ideal steer angle change	rad
ϵ_B	EPSB	I	Acceptable error in the force balance between the vehicle structure and barrier	lbs

ANALYTICAL SYMBOL	PROGRAM SYMBOL	EQN NO.	DEFINITION	UNITS
ϵ_F, ϵ_R	EPSF EPSR	I	Friction lag in front and rear suspensions	in/sec
ϵ_n	EPSL		Permanent set of the barrier for secondary impacts	in
ϵ_V	EPSV	I	Friction lag in the vehicle-barrier friction force	in/sec
ϵ_ψ	EPSPS	I	Friction lag in steering system	deg/sec
ζ_B	ZETAB	I	Threshold value of wheel rotational velocity below which logic is applied to limit brake torques	rad/sec
ζ_i		171	Suspension displacement of the relative to the vehicle from the position of static equilibrium	in
$(\zeta_0)_n, (\zeta_1)_n$ $(\zeta_2)_n$	CD0 CD1 CD2		Coefficients for unloading force deflection characteristic of the barrier	
θ_c	THESKD	336	Vehicle slip angle	rad
θ_{G_i}	THGI(4)	124	Pitch angle of terrain under wheel i relative to the space axes	rad
θ'_n	THETN		Value of θ at t=0 or at the nth indexing of the axes	rad
ϕ'_t	THETT	57	integrated value of $\dot{\theta}$ from t=0 or the nth indexing of the axes	
θ'_{xG_i}		101	Angle between the x axis and the tire-terrain contact plane at wheel i	rad
λ_B	TLAMB	204	Coefficient for inertial coupling terms in relationships for driving end of vehicle	
$\lambda_F\ \lambda_R$	XLAMF XLAMR	I	Ratio of conserved to absorbed energy in the front and rear suspension bumpers or multiple of K_F, K_R for use in simulating suspension bumpers	
λ_T	XLAMT	I	Multiple of K_T for use in non-linear range of tire deflection	
$\lambda_{1i}\ \lambda_{2i}$ λ_{3i}	XLM1(4) XLM2(4) XLM3(4)	107 108 109	Contants for simultaneous solution of the ground contact point	
μ_B	AMUB	I	Effective coefficient of friction between the vehicle sprung mass and barrier	
μ_c	AMUC	I	Tire-curb friction factor	

ANALYTICAL SYMBOL	PROGRAM SYMBOL	EQN NO	DEFINITION	UNITS
μ_{G_i}	XMUGI(4)	I	Nominal coefficient of friction between tire i and ground	
μ_i	XMUI(4)	I	Peak value of friction coefficient for side forces for prevailing conditions of speed and load at wheel i	
μ_{m_i}	XMUM(4)	I	Nominal test surface friction coefficient on which tire properties were measured	
μ_{x_i}	XMUX(4)	240	Effective friction coefficient between tire and terrain at wheel i in the direction along the tire circumference	
$\mu_{x_{p_i}}$	XMUXP(4)	I	Peak circumferential friction coefficient for tire i	
$\mu_{x_{s_i}}$	XMUXS(4)	I	Sliding circumferential friction coefficient for tire i	
π	PI		3.14159...	
ρ	RHO	I	Distance between rear axle center of gravity and roll center, positive for roll center above c.g.	in
ρ_F	RHOF	I	Distance between front axle center of gravity and roll center, positive for roll center above c.g.	in
ρ_{s_i}	RHOS(I)	198	Ratio of circumferential to peak side force friction coefficients for prevailing conditions of speed and load	
$(\rho_{si})_{max}$	RHOMAX	198	Maximum value of si at the existing forward velocity of wheel i	
σ_R	SIGR	I	Coefficients for the polynominal form of barrier load deflection characteristic	
σ_T	SIGT	I	Maximum radial tire deflection for quasi-linear load-deflection characteristic	in
τ_A	TAUA	I	Ambient temperature	°F
τ_i	TAU(4)		Temperature of brake assembly	°F
τ_{i_o}	TAUO(4)	I	Initial temperature of brake assembly	°F
ϕ, θ, ψ	PHIT THETT PSIT		Euler angles of sprung mass axes relative to inertial axes	rad
ϕ_c ϕ_{c_R}	PHIC(50) PHIRC(50)	I	Table of front and rear wheel camber as a function of deflection	deg
ϕ_{cG_i}	PHICI(4)	86	Camber angles of wheels relative to the normal to tire-terrain contact plane	rad
ϕ_{c_1}, ϕ_{c_2} ϕ_{c_3}, ϕ_{c_4} ϕ_{c_5}, ϕ_{c_6}	PHIC1, PHIC2 PHIC3, PHIC4 PHIC5, PHIC6	I	Curb slope angles	rad

ANALYTICAL SYMBOL	PROGRAM SYMBOL	EQN NO	DEFINITION	UNITS
ϕ_F	PHIF		Angular displacement of front axle relative to the vehicle about a line parallel to the x-axis through the front roll center	rad
ϕ_{G_i}	PHGI(4)	125	Camber angle of terrain under wheel i	rad
ϕ_i	PHII(4)		Camber angles of four wheels relative to vehicle	rad
ϕ'_n	PHIN		Value of at t=0 or at the nth indexing of the axes	rad
ϕ_R	PHIR		Angular displacement of rear axle relative to the vehicle about a line parallel to the x - axis through the rear roll center	rad
ϕ'_T	PHIT	58	Integrated value of $\dot{\varphi}$ from t=0 or the nth axis indexing	rad
ϕ_{yG_i}		105	Angle between y axis and tire-terrain contact plane	rad
ψ_{BDRY}	PSBDRY(4,5)	I	Angle of interpolation boundaries in terrain tables, measured from the x'axis	rad
ψ_f	PSIF(50)	I	Table of front wheel steer angle vs time	rad
ψ_i	PSII(4)		Steer angles of wheels relative to vehicle (positive-clockwise as viewed from above)	rad
ψ'_i	PSIIP(4)	89	Steer angles of wheels in tire-terrain contact plane	rad
ψ'_n	PSIN		Value of ψ at t=0 or the nth indexing of the axes	rad
ψ'_t	PSIT	59	Integrated value of $\dot{\psi}$ from t=0 or the nth axis indexing	rad
Ω_F Ω_R	OMEGF OMEGR	I	Maximum suspension deflections from the equilibrium position for linear load-deflection characteristic of the springs	in
Ω_{FC} Ω_{RC}	OMEGFC OMEGRC	I	Front and rear suspension deflections at which the compression bumpers are contacted, measured at the front wheels and the rear springs	in
Ω_{FE} Ω_{RE}	OMEGFE OMEGRE	I	Front and rear suspension deflections at which the extension bumpers are contacted, measured at the front wheels and rear springs	in
Ω_T	OMEGT	I	Multiple of A_2 at which the assumed parabolic variations of small angle cornering and camber stiffnesses with tire loading are abandoned	
Ω	OMGPS	I	Front wheel steering angle at which the linear steering stops are engaged	rad

PROGRAM VARIABLE	R D	V D	COMMON BLOCK	ANALYTICAL VARIABLE OR EXPRESSION
A	U	U	INPT	a
AA1	U		BARIER	AA_1
AA2	U		BARIER	AA_2
AAA	U	U	INPT	α
AAR		A	INPT4	NOT USED
ABSUGW		U	COMP5	$/U_{GW_i}/$
AE		U	DRIVE	$\vert e_i \vert$
AINTI	U		BARIER	$(A_{INT})_i$
AINTP	U		BARIER	$(A_{INT})_{t-1}$
AJMTX	U	U	COMPN	$[A_j]$
AKDS	U	U	INSUS	$K_{\delta s}$
AKDS1	U	U	INSUS	$K_{\delta s1}$
AKDS2	U	U	INSUS	$K_{\delta s2}$
AKDS3	U	U	INSUS	$K_{\delta s3}$
AKF	U	U	INPT	K_F
AKFC	U	U	INPT3	K_{FC}
AKFCP	U	U	INPT3	K'_{FC}
AKFE	U	U	INPT3	K_{FE}
AKFEP	U	U	INPT3	K'_{FE}
AKPS	U	U	INPT1	K_ψ
AKR	U	U	INPT	K_R
AKRC	U	U	INPT3	K_{RC}
AKRCP	U	U	INPT3	K'_{RC}
AKRE	U	U	INPT3	K_{RE}
AKREP	U	U	INPT3	K'_{RE}
AKRS	U	U	INPT	K_{RS}
AKST	U		BARSTR	K_{ST}
AKT	U	U	TIRIN	K_T
AKV	U		INPT2	K_V
AK1		U	INPT5	K_1

PROGRAM VARIABLE	R D	V D	COMMON BLOCK	ANALYTICAL VARIABLE OR EXPRESSION
AK2		U	INPT5	K_2
AMTX	U	U	DIMV	$[A]$
AMU	U	U	TIRIN	μ
AMUB	U		INPT2	μ_B
AMUC	U	U	INPT1	μ_C
AMUCMP	A	A	COMPN	NOT USED
AMUF	U	U	COMP	aM_{UF}
AMUG	U	U	INPT	AMUG(n)
ANG1	A	A	COMP	NOT USED
ANG2	A	A	COMP	NOT USED
A02APB	U	U	COMP	$aM_s g/2(a+b)$
APB		U	DRIVE	$a + b$
APD		U	DRIVE	APD
APDMAX		U	DRIVI	APDMAX
APSI		U	DRIVE	
APSIM		U	DRIVE	
APF	U	U		$\overline{AP}_F$
APFR	U	U	APTABL	$\overline{AP}_F, \overline{AP}_R$
APITCH	U	U		F_{APi}
APR	U	U		$\overline{AP}_R$
APTCH1	U	U	ADTNL	F_{AP1}
APTCH2	U	U	ADTNL	F_{AP2}
APTCH3	U	U	ADTNL	F_{AP3}
APTCH4	U	U	AFTNL	F_{AP4}
ARBR		U	INPT4	$\overline{AR}_F, \overline{AR}_R$
ARBRF		U		$\overline{AR}_F$
ARBRI		U	COMP4	$\overline{AR}_F, \overline{AR}_R$
ARBRR		U		$\overline{AR}_R$

PROGRAM VARIABLE	R D	V D	COMMON BLOCK	ANALYTICAL VARIABLE OR EXPRESSION
ARCAPE		U	DRIVE	$WE_i WI_i e_i$
AREI		U	DRIVE	e_i
ARFAC1		U	COMP4	$\frac{6\ \overline{AR}_j I_{wj}}{(I_{wj} + 1/4\ I_{Dj} \overline{AR}_j^{\,2})^2 + (1/4\ I_{Dj} \overline{AR}_j^{\,2})^2}$
ARFAC2		U	COMP4	$6\ \overline{AR}_j/(I_{wj} + 1/4(I_{Dj} \overline{AR}_j^{\,2}))$
ARFAC3		U	COMP5	$12\ I_{wj}$
ARTQ6		A	COMP4	NOT USED
AS	U	U	DIMV	a_{s_i}
AX	U	U	DIMV	a_{x_i}
AXP		U	DRIVE	a'_x
AXMF02	U	U	COMP	$aM_{UF}/2$
AY	U	U	DIMV	a_{y_i}
AYP		U	DRIVE	a'_y
AO	U	U	TIRIN	A_o
A1	U	U	TIRIN	A_1
A12	U	U	TIRIN	A_1/A_2
A2	U	U	TIRIN	A_2
A23	U	U	TIRIN	A_2A_3/A_1
A234	U	U	TIRIN	A_2A_3/A_4
A3	U	U	TIRIN	A_3
A4	U	U	TIRIN	A_4
B	U	U	INPT	b
BB1	U		BARIER	BB_1
BB2	U		BARIER	BB_2
BET	U	U	INPI	β
BETBR	U	U	DIMV	$\overline{\beta}_i$

PROGRAM VARIABLE	R D	V D	COMMON BLOCK	ANALYTICAL VARIABLE OR EXPRESSION
BETP	U	U	DIMV	β'_i
BETR		A	INPT4	NOT USED
BFP1		U	DRIVI	B_{FP1}
BFP2		U	DRIVI	B_{FP2}
BMTX	U	U	COMPN	[B]
BMUR	U	U	COMP	bM_{UR}
BNMTX	U	U	EINDEX	$[B_n]$
B02APB	U	U	COMP	$bM_s g/2(a+b)$
BROMUR	U	U	COMP	ρbM_{UR}
BRPM		U	INPT5	
BS	U	U	DIMV	b_{s_i}
BTLF		U	INPT5	
BTT		U	INPT5	
BX	U	U	DIMV	b_{x_i}
BXMRØ2	U	U	SUSCMP	$bM_{UR}/2$
BY	U	U	DIMV	b_{y_i}
CAB	U		BARIER	$\cos\alpha_B$
CABT	U		BARIER	$\cos\alpha_{BT}$
CAB1	U		BARIER	$\cos\alpha_{B_1}$
CAC	U	U	DIMV	$\cos\alpha_{C_i}$
CAGZ	U	U	DIMV	$\cos\alpha_{GZ'_i}$
CAH	U	U	DIMV	$\cos\alpha_{h_i}$
CAR	U	U	DIMV	$\cos\alpha_{R_i}$
CAS	U	U	DIMV	$\cos\alpha_{S_i}$
CAX	U	U	COMP	$\cos\alpha_x$
CAXW	A	A	DIMV	NOT USED

PROGRAM VARIABLE	R D	V D	COMMON BLOCK	ANALYTICAL VARIABLE OR EXPRESSION
CAY	U	U	COMP	$\cos\alpha_{Y}$
CAYW	U	U	DIMV	$\cos\alpha_{YW_i}$
CBB	U		BARIER	$\cos\beta_{B}$
CBBT	U		BARIER	$\cos\beta_{BT}$
CBB1	U		BARIER	$\cos\beta_{B1}$
CBC	U	U	DIMV	$\cos\beta_{C_i}$
CBGZ	U	U	DIMV	$\cos\beta_{GZ'_i}$
CBH	U	U	DIMV	$\cos\beta_{h_i}$
CBR	U	U	DIMV	$\cos\beta_{R_i}$
CBS	U	U	DIMV	$\cos\beta_{S_i}$
CBX	U	U	COMP	$\cos\ \beta_{X}$
CBXW	A	A	DIMV	NOT USED
CBY	U	U	COMP	$\cos\ \beta_{Y}$
CBYW	U	U	DIMV	$\cos\beta_{YW_i}$
CC1	U		BARIER	CC_1
CC2	U		BARIER	CC_2
CF	U	U	INPT	C_F
CFP	U	U	INPT	C'_F
CGB	U		BARIER	$\cos\ \gamma_{B}$
CGBT	U		BARIER	$\cos\ \gamma_{BT}$
CGB1	U		BARIER	$\cos\ \gamma_{B1}$
CGC	U	U	DIMV	$\cos\ \gamma_{C_i}$
CGGZ	U	U	DIMV	$\cos\ \gamma_{GZ'_i}$
CGH	U	U	DIMV	$\cos\ \gamma_{h_j}$
CGR	U	U	DIMV	$\cos\ \gamma_{R_i}$
CGS	U	U	DIMV	$\cos\ \gamma_{S_i}$

PROGRAM VARIABLE	R D	V D	COMMON BLOCK	ANALYTICAL VARIABLE OR EXPRESSION
CGX	U	U	COMP	$\cos\ \gamma_{X}$
CGXW	A	A	DIMV	NOT USED
CGY	U	U	COMP	$\cos\ \gamma_{Y}$
CGYW	U	U	DIMV	$\cos\ \gamma_{YW_1}$
CHED	U	U	HEAD	CONTROL TITLE
CMTX	U	U	DIMV	$[C_j]$
CNMTX	U	U	EINDEX	$[C_n]$
COMEN4		U	INPT4	CØMEN4
COMEN5		A	COMP5	NOT USED
CONE		U	INPT5	C_1
CONMPH		U	DRIVE	3600/(12x5280)
CONS	U	A	INPT2	$\overline{\text{CONS}}$
COSPH	U	U	COMP	$\cos\ \emptyset$
COSPHN	U	U	EINDEX	$\cos\ \emptyset_{n}$
COSPS	U	U	COMP	$\cos\ \psi$
COSPSN	U	U	EINDEX	$\cos\ \psi_{n}$
COSTH	U	U	COMP	$\cos\ \Theta$
COSTHN	U	U	EINDEX	$\cos\ \Theta_{n}$
CPG	U	U	DIMV	$\cos\ \emptyset_{G_i}$
CPHI	A	A	COMP	NOT USED
CPHIC	U	A	ADTNL	$\cos\ \emptyset_{C_i}$
CPHICI		U	COMP4	$\cos\ \emptyset_{C_i}$
CPHTP	U	U	COMP	$\cos\ \emptyset_{t}$
CPSI	A	A	COMP	NOT USED
CPSP	U	U	INPT1	C'_{ψ}
CPSTP	U	U	EINDEX	$\cos\psi'_{t}$
CPYG	U	U	DIMV	$\cos\ \emptyset_{y_{Gi}}$
CR	U	U	INPT	C_R
CRP	U	U	INPT	C_R'

PROGRAM VARIABLE	R D	V D	COMMON BLOCK	ANALYTICAL VARIABLE OR EXPRESSION
CS	U	U	DIMV	C_{Si}
CT		U	INPT4	C_{Ti}
CTG	U	U	DIMV	$\cos \phi_{G_i}$
CTHETP	U	U	EINDEX	$\cos \Theta_t$
CTHREE		U	INPT5	C_3
CTWO		U	INPT5	C_2
CTXG	U	U	DIMV	$\cos\Theta_{XGi}$
CX	U	U	DIMV	C_{x_i}
CY	U	U	DIMV	C_{y_i}
DADE	U	U	INPT	DATE ARRAY
DAPFB	U	U	APTABL	
DADFE	U	U	APTBL	
DAPRB	U	U	APTABL	
DAPRE	U	U	APTABL	
DDAPF	U	U	APTABL	
DDAPR	U	U	APTABL	
DDD	A		INPT2	NOT USED
DDEL	U	U	INPT	DDEL
DDEL1	U	U		$\dot{\delta}_1$
DDEL1D	U	U		$\ddot{\delta}_1$
DDEL2	U	U		$\dot{\delta}_2$
DDEL2D	U	U		$\ddot{\delta}_2$
DDEL3	U	U		$\dot{\delta}_3$
DDEL3D	U	U		$\ddot{\delta}_3$
DDEL4	U	U		$\dot{\delta}_4$
DDEL4D	U	U		$\ddot{\delta}_4$
DDPSFI	U	U		$\ddot{\psi}_F$
DD1M2	U	U	COMP	$\dot{\delta}_1-\dot{\delta}_2$

PROGRAM VARIABLE	R D	V D	COMMON BLOCK	ANALYTICAL VARIABLE OR EXPRESSION
DD1P2	U	U	COMP	$\dot{\delta}_1+\dot{\delta}_2$
DD3M4	U	U	SUSCMP	$\dot{\delta}_3-\dot{\delta}_4$
DD3P4	U	U	SUSCMP	$\dot{\delta}_3+\dot{\delta}_4$
DELB	U	U	INPT	DELB
DELBB	U		BARIER	δ_B
DELBBP		U	BARIER	$(\delta_B)_{t-1}$
DELE	U	U	INPT	DELE
DELG	U	U	RUFNES	ΔG
DELPTH	U	U	DRFVTT	EMDT
DELTA	U	U	DIMV	Δ_i
DELTAE		U	COMP5	ΔE_i
DELTAX		U	DRIVE	D_{ax}
DELTB	U		INPT2	Δt_B
DELTC	U	U	INPT1	Δt_c
DELTY		U	DRIVE	
DELX	U		BARIER	
DELYBP	U		INPT2	$\Delta y'_B$
DEL1	U	U		δ_1
DEL1D	U	U		$\dot{\delta}_1$
DEL10	U	U	INPT	δ_{1o}
DEL10D	U	U	INPT	$\dot{\delta}_{1o}$
DEL2	U	U		δ_2
DEL2D	U	U		$\dot{\delta}_2$
DEL20	U	U	INPT	δ_{2o}
DEL20D	U	U	INPT	$\dot{\delta}_{2o}$
DEL3	U	U		δ_3
DEL3D	U	U		$\dot{\delta}_3$
DEL30	U	U	INPT	δ_{3o}
DEL30D	U	U	INPT	$\dot{\delta}_{3o}$
DEL4	U	U		δ_4
DEL4D	U	U		$\dot{\delta}_4$

PROGRAM VARIABLE	R D	V D	COMMON BLOCK	ANALYTICAL VARIABLE OR EXPRESSION
DEL40	U	U	INSUS	δ_{40}
DEL40D	U	U	INSUS	$\dot{\delta}_{40}$
DEND		U	DRIVE	
DER	U	U	INTG	$\dot{y}$
DERR		A	INTR	NOT USED
DESS		U	DRIVE	DS
DESSI		U	DRIVI	
DGMAX	U	U	RUFNES	
DI		U	DRIVE	
DISS	U		BARIER	
DIST		U	DRIVE	DIST
DISTC		U	DRIVE	
DISTD	U	U	COMP	$\sqrt{D_{1_i}^{2} + D_{2_i}^{2} + D_{3_i}^{2}}$
DISTI		U	DRIVI	
DISTS	U	U	COMP	$\sqrt{a_{s_i}^{2} + b_{s_i}^{2} + c_{s_i}^{2}}$
DISTX	U	U	COMP	$\sqrt{a_{x_i}^{2} + b_{x_i}^{2} + c_{x_i}^{2}}$
DISTY	U	U	COMP	$\sqrt{a_{y_i}^{2} + b_{y_i}^{2} + c_{y_i}^{2}}$
DMATX	U	U	DIMV	[D] and [E]
DP	U	U		$\dot{P}$
DPHIF	U	U		$\dot{\emptyset}_F$
DPHIFD	U	U		$\ddot{\emptyset}_F$
DPHIR	U	U		$\dot{\emptyset}_R$
DPHIRD	U	U		$\ddot{\emptyset}_R$
DPHITP	U	U		$\dot{\emptyset}'_t$

PROGRAM VARIABLE	R D	V D	COMMON BLOCK	ANALYTICAL VARIABLE OR EXPRESSION
DPSIFI	U	U		$\dot{\psi}_F$
DPSILF		U	DRIVE	$\Delta\psi_{Fj}(t)$
DPSINT	A	A	COMPN	NOT USED
DPSISF		U	DRIVE	$\Delta\psi_{fi}$
DPSITP	U	U		$\ddot{\psi}'_t$
DQ	U	U		$\dot{Q}$
DR	U	U		$\dot{R}$
DRIEND		A	DRIVI	NOT USED
DRPSI		U		$\frac{d}{dt}\,(RPS)_i$
DRWHJ	U	U	INPT1	DRWHJ
DS		U	DRIVI	ΔS
DSØES		U	DRIVE	
DT	U	U	INTG	Δt
DTCMP1	A	A	INPT	NOT USED
DTCOMP	U	U	INPT	Δt
DTDD1	U	U	SUSCMP	$d(\Delta T_{HF1})/d\delta_1$
DTDD2	U	U	SUSCMP	$d(\Delta T_{HF2})/d\delta_2$
DTDD3	U	U	SUSCMP	$d(\Delta T_{HR3})/d\delta_3$
DTDD4	U	U	SUSCMP	$d(\Delta T_{HR4})/d\delta_4$
DTHF	U	U	INSUS	
DTHF1	U	U	SUSCMP	ΔT_{HF1}
DTHF2	U	U	SUSCMP	ΔT_{HF2}
DTHR	U	U	INSUS	
DTHR3	U	U	SUSCMP	ΔT_{HR3}
DTHR4	U	U	SUSCMP	ΔT_{HR4}
DTHTTP	U	U		$\dot{\Theta}'_t$
DTINT		U	COMP4	$(RPS)_i/\frac{d(RPS_i)}{dt}$
DTLF		U	INPT5	

PROGRAM VARIABLE	R D	V D	COMMON BLOCK	ANALYTICAL VARIABLE OR EXPRESSION
DTPRNT	U	U	INPT	
DTR		U	INTR	Δt_n
DTSTEP		U	COMP4	
DTT		U	INPT5	
DTTEST		U	COMP4	$(RPS)/\frac{d(RPS)_i}{dt}$
DU	U	U		$\dot{u}$
DV	U	U		$\dot{v}$
DW	U	U		$\dot{w}$
DXCP	U	U		$\dot{u}'$
DYCP	U	U		$\dot{v}'$
DZCP	U	U		$\dot{w}'$
D1	U	U	DIMV	D_{1i}
D1MD2	U	U	COMP	$\delta_1-\delta_2$
D1PD2	U	U	COMP	$\delta_1+\delta_2$
D2	U	U	DIMV	D_{2i}
D21	U	U	COMP	$\delta_2-\delta_1$
D3	U	U	DIMV	D_{3i}
D3MD4	U	U	SUSCMP	$\delta_3-\delta_4$
D3PD4	U	U	SUSCMP	$\delta_3+\delta_4$
D43	U	U	SUSCMP	$\delta_4-\delta_3$
EBAR	U	U	INPT	$\overline{E}$
EEE	U		BARIER	$(E_1)_t$
EI		U	DRIVE	
EPSL	U		BARIER	ε_{n-1}
EM	U	U	INPT	$\overline{M}$
EN		U	DRIVE	EN
ENDEIN	A	A	EINDEX	NOT USED
EMDT		U	DRIVI	EMDT
END3	A	A	INPT3	NOT USED

PROGRAM VARIABLE	R D	V D	COMMON BLOCK	ANALYTICAL VARIABLE OR EXPRESSION
ENRGY	U		BARIER	ΣE
				t
EPSB	U		INPT2	ε_B
EPSE	U	U	INPT	ε_F
EPSL	A		BARIER	
EPSPS	U	U	INPT1	ε_ψ
EPSR	U	U	INPT	ε_R
EPSS		U	COMP4	ε_{s_i}
EPSSFC		U	COMP4	$\varepsilon_{Si}F_{Ci}$
EPST	A		INPT2	NOT USED
EPSV	U		INPT2	ε_V
ERPM		U	INPT5	
ES		U	DRIVE	
ET		U	DRIVE	$\Sigma WE_i WI_i e_i$
ETLF		U	INPT5	
ETT		U	INPT5	
EWT		U	DRIVE	$WE_i WI_i e_i$
FP	U		BARIER	F_B
FBRK		U	DRIVE	F_{BRK}
FC	U	U	DIMV	F_{Ci}
FCAV		U	COMP4	$(\Sigma F_{C_j}\Delta t_n)/\Delta t$
FCSLSM		U	COMP4	
FCXFAC		U	COMP4	$A_{11}\cos\alpha_{C_i}+A_{21}\cos\beta_{C_i}+A_{31}\mathrm{cis}\gamma_{C_i}$
FCXU	U	U	DIMV	F_{CXU_i}
FCYFAC		U	COMP4	$A_{12}\cos\alpha_{C_i}+A_{22}\cos\beta_{C_i}+A_{32}\cos\gamma_{C_i}$
FCYU	U	U	DIMV	F_{cyu_i}
FCZFAC		U	COMP4	$A_{13}\cos\alpha_{C_i}+A_{23}\cos\beta_{C_i}+A_{33}\cos\gamma_{C_i}$

PROGRAM VARIABLE	R D	V D	COMMON BLOCK	ANALYTICAL VARIABLE OR EXPRESSION
FCZU	U	U	DIMV	$FCZU_i$
FIDAR		A	COMP4	NOT USED
FIDIW		A	COMP4	NOT USED
FIDJ		U	INPT4	I_{DF}, I_{DR}
FIDJF		U		I_{DF}
FIDJR		U		I_{DR}
FIDWR2		A	COMP4	NOT USED
FIWJ		U	INPT4	I_{WF}, I_{WR}
FIWJF		U		I_{WF}
FIWJR		U		I_{WR}
FJF	U	U	SUSCMP	F_{JFi}
FJP	U	U	TIRIN	F_j'
FKD		U	DRIVE	Kd
FKDO		U	DRIVI	Kd
FKP		U	DRIVE	K_p
FKPO		U	DRIVI	K_p
FKS1		U	DRIVE	K_{s_1}
FKS10		U	DRIVI	K_{s_1}
FKS2		U	DRIVE	K_{s_2}
FKS20		U	DRIVI	K_{s_2}
FKSKDO		U	DRIVI	K_s
FKSKID		U	DRIVE	K_s
FN	U		BARIER	F_N
FNP	U		BARIER	$(F_N)_{t-1}$
FNSTI	U		BARSTR	F_{NSTi}
FR	U	U	DIMV	F_{Ri}
FRCP	U	U	COMPN	F'_{R_i}
FRCPAV		U	COMP4	$(\Sigma F'_{R_i} \Delta t_n)/\Delta t$
FRCMPU		U	COMP4	$\mu_i F'_{R_i}$

PROGRAM VARIABLE	R D	V D	COMMON BLOCK	ANALYTICAL VARIABLE OR EXPRESSION
FRICF	U		HARDPT	$\frac{\mu_B F_{NSTi}}{FRICT}$
FRICT	U		BARIER	
FRSP	A	A	COMPN	NOT USED
FRTEST		U	COMP4	$F_{R_i} - F_{S_i} \sin \emptyset_{C_i}$
FRXFAC		U	COMP4	$A_{11}\cos\alpha_{GZ'_i} + A_{21}\cos\beta_{GZ'_i} + A_{31}\cos\gamma_{GZ'_i}$
FRXU	U	U	DIMV	F_{Rxu_i}
FRYFAC		U	COMP4	$A_{12}\cos\alpha_{GZ'_i} + A_{22}\cos\beta_{GZ'_i} + A_{32}\cos\gamma_{GZ'_i}$
FRYU	U	U	DIMV	F_{Ryu_i}
FRZFAC		U	COMP4	$A_{13}\cos\alpha_{GZ'_i} + A_{23}\cos\beta_{GZ'_i} + A_{33}\cos\gamma_{GZ'_i}$
FRZU	U	U	DIMV	F_{Rzu_i}
FS	U	U	DIMV	F_{S_i}
FSAV		U	COMP4	$(\Sigma F_{S_i} \Delta t_n)/\Delta t$
FSXFAC		U	COMP4	$A_{11}\cos\alpha_{S_i} + A_{21}\cos\beta_{S_i} + A_{31}\cos\gamma_{S_i}$
FSXU	U	U	DIMV	$F_{SX_{ui}}$
FSYFAC		U	COMP4	$A_{12}\cos\alpha_{S_i} + A_{22}\cos\beta_{S_i} + A_{32}\cos\gamma_{S_i}$
FSYU	U	U	DIMV	F_{Syu_i}
FSZFAC		U	COMP4	$A_{13}\cos\alpha_{S_i} + A_{23}\cos\beta_{S_i} + A_{33}\cos\gamma_{S_i}$
FSZU	U	U	DIMV	F_{Szu_i}
FXU	U	U	DIMV	F_{xu_i}
FYU	U	U	DIMV	F_{yu_i}
FZU	U	U	DIMV	F_{zu_i}
F1FI	U	U	DIMV	F_{1Fi}
F1RI	U	U	DIMV	F_{1Ri}
F2FI	U	U	DIMV	F_{2Fi}

PROGRAM VARIABLE	R D	V D	COMMON BLOCK	ANALYTICAL VARIABLE OR EXPRESSION
F2RI	U	U	DIMV	F_{2Ri}
G	U	U	INPT	g
GAM1	U	U	COMP	γ_1
GAM2	U	U	COMP	$(\gamma_2)_t$
GAM3	U	U	COMP	$(\gamma_3)_t$
GAM4	U	U	COMP	$(\gamma_4)_t$
GAM5	U	U	COMP	$(\gamma_5)_t$
GAM6	U	U	COMP	$(\gamma_6)_t$
GAM7	U	U	COMP	$(\gamma_7)_t$
GAM8	U	U	COMP	$(\gamma_8)_t$
GAM9	U	U	COMP	$(\gamma_9)_t$
GCTCP	U	U	COMP	$g\ A_{33}$
GCTH	U	U	COMP	$g \cos \Theta$
GCTSP	U	U	COMP	$g\ A_{32}$
GEAR1		U	DRIVI	$GEAR_1$
GEAR2		U	DRIVI	$GEAR_2$
GEAR3		U	DRIVI	$GEAR_3$
GEAR4		U	DRIVI	$GEAR_4$
GHED	U	U	HEAD	TERRAIN TITLE
GN		U	INPT5	G_{iF}, G_{iR}
GSTH	U	U	COMP	$g \sin \Theta$
HCAH	U	U		$h_i \cos\alpha_{h_i}$
HCAH1	U	U	COMP	$h_1 \cos\alpha_{h_i}$
HCAH2	U	U	COMP	$h_2 \cos\alpha_{h_2}$
HCAH3	U	U	COMP	$h_3 \cos\alpha_{h_3}$
HACH4	U	U	COMP	$h_4 \cos\alpha_{h_4}$

PROGRAM VARIABLE	R D	V D	COMMON BLOCK	ANALYTICAL VARIABLE OR EXPRESSION
HCBH	U	U		$h_i \cos\beta_{h_i}$
HCBH1	U	U	COMP	$h_1 \cos\beta_{h_1}$
HCBH2	U	U	COMP	$h_2 \cos\beta_{h_2}$
HCBH3	U	U	COMP	$h_3 \cos\beta_{h_3}$
HCBH4	U	U	COMP	$h_4 \cos\beta_{h_4}$
HCGH	U	U		$h_i \cos\gamma_{h_i}$
HCGH1	U	U	COMP	$h_1 \cos\gamma_{h_1}$
HCGH2	U	U	COMP	$h_2 \cos\gamma_{h_2}$
HCGH3	U	U	COMP	$h_3 \cos\gamma_{h_3}$
HCGH4	U	U	COMP	$h_4 \cos\gamma_{h_4}$
HED	U	U	INPT	RUN TITLE
HI	U	U	DIMV	h_i
HMAX	U	U	INPT	h_{max}
HMIN	U	U	INPT	h_{min}
HMINR		A	INPT4	NOT USED
HRPSFA		A	COMP4	NOT USED
HRPSFB		A	COMP4	NOT USED
HRPSFC		A	COMP4	NOT USED
HTRERM		U	COMP4	$/h_i (RPS)_i/$
IAPFR	U	U	APTABL	
IBHIT	U		BARIER	
IBTYP		U	INPT5	TYPE
IBUG		U	INPT5	
ICBHIT	U	U	COMPN	
IDPT	U		BARIER	
IDRIVE		U	DRIVTT	

PROGRAM VARIABLE	R D	V D	COMMON BLOCK	ANALYTICAL VARIABLE OR EXPRESSION
IDRIVER		U	DRIVTT	
IDTCNT		U	COMP4	
IGEAR		U	DRIVE	
IHIT	U	U	COMPN	
ILOAD	U		BARIER	
INDB	U		INPT2	
INDCRB	U	U	INPT1	
INDXPT	U			
ININD	U		BARIER	
IPATHT		U	DRIVTT	
IPLN	U		BARIER	
IPT	U		BARIER	
IRPS		U	COMP4	
IRUF	U	U	RUFNES	
ISKIDP		U	DRIVE	
ISMAIN		U	DRIVE	
ISTEP		U	COMP4	
ISTOP		U	COMP4	
ISTOP	U		NSTOP	
ISUS	U	U	INSUS	
ITCHNG		U	DRIVTT	
ITESTT		U	DRIVTT	
ITIR	U	U	TIRIN	
IUVB		U	COMP4	
IUVS		U	COMP4	
IX	U	U	COMP	
IY	U	U	COMP	
I1	U		BARIER	
I2	U		BARIER	
I3	U		BARIER	
I4	U		BARIER	

PROGRAM VARIABLE	R D	V D	COMMON BLOCK	ANALYTICAL VARIABLE OR EXPRESSION
JBHIT	U		BARIER	
JCBHIT	U	U	COMPN	
JDEND		U	COMP5	
KCOUNT		U	DRIVE	
LCB1	U	U	COMPN	
LCB2	U	U	COMPN	
LLL	U	U	COMP	
MODE	U	U	INPT	
NAPF	U	U	APTABL	
NAPR	U	U	APTABL	
NBTYP		U	COMP5	
NBX	U	U	INPT	
NBY	U	U	INPT	
NCAMF	U	U	INSUS	
NCAMR	U	U	INSUS	
NCRBSL	U	U	NEWCRB	
NCYC	U		BARIER	
NDEL	U	U	INPT	NDEL
NDTHF	U	U	INSUS	
NDTHR	U	U	INSUS	
NEN		U	DRIVI	
NEND	U	U	RUFNES	
NEQ	U	U	INTG	
NEQR		A	INTR	NOT USED
NLDCTR	U		BARIER	

PROGRAM VARIABLE	R D	V D	COMMON BLOCK	ANALYTICAL VARIABLE OR EXPRESSION
NPAGE	U	U	HEAD	
NPD		U	DRIVE	
NRPM		U	INPT5	
NSEG		U	BARIER	
NTBL1	U	U	INPT	
NTBL2	U	U	INPT	
NTBL3	U	U	INPT	
NTLF		U	INPT5	
NTRAN		U	DRIVI	
NTTS		U	INPT5	
NTTI		U	INPT5	
NTT2		U	INPT5	
NTT3		U	INPT5	
NUNLD	U		BARIER	
NX	U	U	INPT	
NXFRCP		U	INPT4	
NXUGMU		U	INPT4	
NY	U	U	INPT	
NZTAB	U	U	INPT	
NZ5	U	U	INPT	
OMEGAO		U	DRIVI	
OMEGF	A	A	INPT	NOT USED
OMEGFC	U	U	INPT3	Ω_{FC}
OMEGFE	U	U	INPT3	Ω_{FE}
OMEGR	A	A	INPT	NOT USED
OMEGRC	U	U	INPT3	Ω_{RC}
OMEGRE	U	U	INPT3	Ω_{RE}
OMEGT	U	U	TIRIN	Ω_T
OMGPS	U	U	INPT1	Ω_ψ

PROGRAM VARIABLE	R D	V D	COMMON BLOCK	ANALYTICAL VARIABLE OR EXPRESSION
OMT2A2	U	U	TIRIN	$\dfrac{\Omega_T A_2 A_3 (A_4 - A_2\Omega_T)}{A_4[\Omega_T A_1 A_2 (\Omega_1 - 1) - A_o]}$
OMT2M1	U	U	TIRIN	$\Omega_T A_1 A_2 (\Omega_T - 1)$
P	U	U		P
PC		U	COMP5	P_c
PCAB	U		BARIER	$(\cos\alpha_B)_{t-1}$
PCBB	U		BARIER	$(\cos\beta_B)_{t-1}$
PCGB	U		BARIER	$(\cos\gamma_B)_{t-1}$
PHFP	U	U	SUSCMP	NOT USED
PHGI	U	U	DIMV	ϕ_{G_i}
PHG1	A	A	COMP	NOT USED
PHG2	A	A	COMP	NOT USED
PHIC	U	U	INPT	ϕ_C
PHICI	U	U	DIMV	ϕ_{CGi}
PHICLR	U	U	NEWCRB	
PHICM	U	U	NEWCRB	
PHIC1	U	U	INPT1	ϕ_{C1} (deg)
PHIC1R	U	U	COMPN	ϕ_{C1} (rad)
PHIC2	U	U	INPT1	ϕ_{C2} (deg)
PHIC2R	U	U	COMPN	ϕ_{C2} (rad)
PHIC3	U	U	NEWCRB	ϕ_{c3} (deg)
PHIC3R	U	U	NEWCRB	ϕ_{c3} (rad)
PHIC4	U	U	NEWCRB	ϕ_{c4} (deg)
PHIC4R	U	U	NEWCRB	ϕ_{c4} (rad)
PHIC5	U	U	NEWCRB	ϕ_{c5} (deg)
PHIC5R	U	U	NEWCRB	ϕ_{c5} (rad)
PHIC6	U	U	NEWCRB	ϕ_{c6} (deg)
PHIC6R	U	U	NEWCRB	ϕ_{c6} (rad)
PHIF	U	U		ϕ_F

PROGRAM VARIABLE	RD	VD	COMMON BLOCK	ANALYTICAL VARIABLE OR EXPRESSION
PHIFD	U	U		$\dot{\phi}_F$
PHIFD2	U	U	SUSCMP	$\dot{\phi}_F^2$
PHIFO	U	U	INSUS	ϕ_{FO}
PHIFDO	U	U	INSUS	$\dot{\phi}_{FO}$
PHIF2	U	U	SUSCMP	ϕ_F^2
PHII	U	U		ϕ_i
PHIN	U	U	COMP	ϕ'_n
PHIR	U	U		ϕ_R
PHIRC	U	U	INSUS	ϕ_{CR}
PHIRD	U	U		ϕ_R
PHIRD2	U	U	COMP	ϕ^2_R
PHIRO	U	U	INPT	ϕ_{R_o}
PHIROD	U	U	INPT	$\dot{\phi}_{R_o}$
PHIR2	U	U	COMP	ϕ^2_R
PHIT	U	U	COMP	ϕ_t or ϕ
PHITL	U	U	EINDEX	ϕ_{t-1}
PHITP	U	U		ϕ'_t
PHIO	U	U	INPT	ϕ_o
PHI1	U	U	DIMV	ϕ_1
PHI1D	U	U	COMPN	$\frac{d\phi_1}{d\delta_1}\dot{\delta}_1$
PHI2	U	U	DIMV	ϕ_2
PHI2D	U	U	COMPN	$\frac{d\phi_2}{d\delta_2}\dot{\delta}_2$
PHI3	U	U	DIMV	ϕ_3
PHI3D	U	U	SUSCMP	$\dot{\phi}_3$
PHI4	U	U	DIMV	ϕ_4
PHI4D	U	U	SUSCMP	$\dot{\phi}_4$
PHRP	A	A	COMP	NOT USED

PROGRAM VARIABLE	RD	VD	COMMON BLOCK	ANALYTICAL VARIABLE OR EXPRESSION
PI	U	U	COMP	π
PI015R		U	COMP5	$15/\pi$
PI02	U	U	EINDEX	$\pi/2$
PI04	U	U	EINDEX	$\pi/4$
PONE		U	INPT5	P_1
PP		U	COMP5	P_j
PPD		U	DRIVE	
PPRB	U		BARIER	$(R_B)_{t-1}$
PQ	U	U	COMP	PQ
PQRMIN	U	U	INPT	
PR	U	U	COMP	PR
PSBDRY	U	U	INPT	Ψ_{BDRY}(rad)
PSBDRO	U	U	INPT	Ψ_{BDRY}(deg)
PSIF	U	U	INPT	$\dot{\Psi}_F$
PSIFDO	U	U	INPT1	Ψ_{Fio}
PSIFFH		U	DRIVE	
PSIFHO		U	DRIVI	
PSIFI	U	U		$\dot{\Psi}_{Fi}$
PSIFID	U	U		Ψ_{Fi}
PSIFIO	U	U	INPT1	Ψ_{Fio}
PSII	U	U		Ψ_i
PSIIP	U	U	DIMV	Ψ'_i
PSIJ		U	DRIVE	
PSIM		U	DRIVE	$(\psi_F)_{IDEAL}$
PSIN	U	U	COMP	Ψ'_n
PSISKD		U	DRIVE	$\Delta\psi_{sj}$
PSIT	U	U	COMP	Ψ_t or Ψ
PSITEM		U	COMP4	Ψ'_i sgn U_{Gi}
PSITL	U	U	EINDEX	Ψ_{t-1}
PSITP	U	U		Ψ'_t
PSIO	U	U	INPT	Ψ_o

PROGRAM VARIABLE	R D	V D	COMMON BLOCK	ANALYTICAL VARIABLE OR EXPRESSION
PSI1	U	U	DIMV	Ψ_1
PSI2	U	U	DIMV	Ψ_2
PSI3	U	U	DIMV	Ψ_3
PSI4	U	U	DIMV	Ψ_4
PSZR	U		BARIER	$(Z_R)_{t-1}$
PTWO		U	INPT5	P_2
PVDEF	U		BARIER	$(y'_{cpm})_t - (y'_{cpm})_{t-1}$
PZERO		U	INPT5	P_{Fo}, P_{Ro}
PO	U	U	INPT	P_o
P1	U	U	COMP	$\cos\beta_{yw_i} \cos\gamma_{GZ'_i}$
P2	U	U	COMP	P^2
P3	U	U	COMP	$\cos\gamma_{yw_i} \cos\alpha_{GZ'_i}$
P4	U	U	COMP	$\cos\gamma_{GZ'_i} \cos\alpha_{yw_i}$
P5	U	U	COMP	$\cos\alpha_{yw_i} \cos\beta_{GZ'_i}$
P6	U	U	COMP	$\cos\alpha_{GZ'_i} \cos\beta_{yw_i}$
P7	U	U	COMP	$\cos\beta_{GZ'_i} \cos\gamma_{yw_i}$
QAY		U	DRIVE	a_y
QR	U	U	COMP	QR
QO	U	U	INPT	Q_O
Q2	U	U	COMP	Q^2
R	U	U		R
RAD	U	U	COMP	$180/\pi$
RB	U		BARIER	$(R_B)_t$
RB1	U		BARIER	R_{B1}
RF	U	U	INPT	R_F

PROGRAM VARIABLE	R D	V D	COMMON BLOCK	ANALYTICAL VARIABLE OR EXPRESSION
RFPF	U	U	SUSCMP	$\rho_F \varnothing_F$
RFTF	U	U	COMP	R_F/T_F^2
RHFMUF	U	U	SUSCMP	$\rho_F M_{UF}$
RHF2MF	U	U	SUSCMP	$\rho_F^2 M_{UF}$
RF2MFI	U	U	SUSCMP	$I_F + \rho_F^2 M_{UF}$
RHMU2	U	U	COMP	$\rho^2 M_{UR}$
RHMR2I	U	U	COMP	$\rho^2 M_{UR} + I_R$
RHO	U	U	INPT	ρ
RHØF	U	U	INSUS	ρ_F
RHOF2	U	U	SUSCMP	ρ_F^2
RHOMAX		U	COMP5	$(\rho_{si})_{max}$
RHOMUR	U	U	COMP	ρM_{UR}
RHOS		U	COMP4	ρ_{S_i}
RHOSAV		U	COMP5	$(\Sigma\rho_{S_i} (\Delta t_n)/\Delta t$
RHOSMX		U	COMP5	
RHO2	U	U	COMP	ρ^2
RPF2M	U	U	SUSCMP	$\rho_F^2 M_{UF} \varnothing_F^2$
RPHFD	U	U	SUSCMP	$R\varnothing_F$
RPHRD	U	U	COMP	$R\varnothing_R$
RPME		U	COMP5	
RPR	U	U	COMP	$\rho\varnothing_R$
RPSFA		U	COMP4	$\dfrac{I_{Wj}+1/4 I_{Dj} AR_j^2}{(I_{Wj}+1/4 I_{Dj} AR_j^2)^2-(1/4 I_{Dj} AR_j)^2}$
RPSFB		U	COMP4	$\dfrac{I_{Dj} AR_j^2}{(4 I_{Wj}+I_{Dj} AR_j^2)-(1/2 I_{Dj} AR_j^2)^2}$
RPSFC		U	COMP4	$1/I_{Wj}+1/4 I_{Dj} AR_j^2$

PROGRAM VARIABLE	R D	V D	COMMON BLOCK	ANALYTICAL VARIABLE OR EXPRESSION
RPSFD		U	COMP4	$\frac{I_{Dj} AR_j^2}{4I_{Wj}+I_{Dj} AR_j^2}$
RPSFE		U	COMP5	$12/(I_{wj} + 1/4\ I_{Dj}\overline{AR}_2^{\,2})$
RPSI		U		$(RPS)_i$
RPSSM		U	COMP4	
RR	U	U	INPT	R_R
RRM		U	INPT4	R_{RMi}
RRMC		U	INPT4	C_{RRMi_2}
RRTR	U	U	SUSCMP	R_R/T_R
RRTS	U	U	COMP	$R_R T_S$
RR1	U		BARIER	RR_1
RR2	U		BARIER	RR_2
RR2P	U		BARIER	$(RR_2)_{t-1}$
RTF	U	U	SUSCMP	R_F/T_{SF}
RTR	U	U	COMP	R_R/T_S
RW	U	U	TIRIN	R_W
RWDRIV		U	COMP5	
RWHJB	U	U	INPT1	RWHJB
RWHJE	U	U	INPT1	RWHJE
RO	U	U	INPT	R_o
R2	U	U	COMP	R^2
S		U	DRIVI	
SDEN	U		BARIER	$\Sigma\ (A_{INT})_i$
SECTP	U	U	COMP	$\sec\ \Theta_t$
SET	U		INPT2	$\overline{SET}$
SFCDTR		U	COMP4	$\Sigma F_{C_i}\ \Delta t_n$
SFRCPR		U	COMP4	$\Sigma F'_{R_i}\ \Delta t_n$

PROGRAM VARIABLE	R D	V D	COMMON BLOCK	ANALYTICAL VARIABLE OR EXPRESSION
SFRX	U	U	COMPN	$\Sigma F_{Rx'_i}$
SFRY	U	U	COMPN	$\Sigma F_{Ry'_i}$
SFRZ	U	U	COMPN	$\Sigma F_{Rz'_i}$
SFSDTY		U	COMP4	$\Sigma F_{S_i}\ \Delta t_n$
SFXS	U	U	COMP	$\Sigma\ F_{XS}$
SFXU	U	U	COMP	$\Sigma\ F_{XU}$
SFYS	U	A	COMP	$\Sigma\ F_{YS}$
SFYU	U	U	COMP	$\Sigma\ F_{YU}$
SFYUF	A	A	COMP	NOT USED
SFYUR	A	A	COMP	NOT USED
SFZS	U	A	COMP	$\Sigma\ F_{ZS}$
SFZU	A	A	COMP	NOT USED
SFZ1	U	U	COMP	$\Sigma\ F_{Z1}$
SHED	U	U	HEAD	INITIAL CONDITION TITLE
SI	U	U	DIMV	S_i
SIGR	U		INPT2	σR_j
SIGT	U	U	TIRIN	σ_T
SINPH	U	U	COMP	$\sin\ \emptyset$
SINPHN	U	U	EINDEX	$\sin\ \emptyset'_n$
SINPS	U	U	COMP	$\sin\ \Psi$
SINPSN	U	U	EINDEX	$\sin\ \Psi'_n$
SINTH	U	U	COMP	$\sin\ \Theta$
SINTHN	U	U	EINDEX	$\sin\ \Theta'_n$
SLIP		U	COMP4	$(SLIP)_i$
SLIPAV		U	COMP4	$[\Sigma(SLIP)_i \Delta t_n]/\Delta t$
SLIPMT		U	INPT4	
SLIPMX		U	COMP5	
SLIPP		U	COMP5	$SLIP_P$
SLIPT		U	COMP4	$/(SLIP)_i/$

PROGRAM VARIABLE	R D	V D	COMMON BLOCK	ANALYTICAL VARIABLE OR EXPRESSION
SLOPE		U	DRIVE	
SLOPER		U	DRIVE	
SLOPE1	U	U	ADTNL	$\frac{d\phi_1}{d\delta_1}$
SLOPE2	U	U	ADTNL	$\frac{d\phi_2}{d\delta_2}$
SLOPE3	U	U	SUSCMP	$d\phi_3/d\delta_3$
SLOPE4	U	U	SUSCMP	$d\phi_4/d\delta_4$
SLPFAC		U	COMP4	h_i/U_{GWi}
SNPF	U	U	SUSCMP	$\Sigma N_{\phi F}$
SNPR	U	U	COMP	$\Sigma N_{\phi R}$
SNPS	U	A	COMP	$\Sigma N_{\phi S}$
SNPSS	U	A	COMP	$\Sigma N_{\Psi S}$
SNPSU	U	U	COMP	$\Sigma N_{\Psi U}$
SNPU	U	U	COMP	$\Sigma N_{\phi U}$
SNTS	U	A	COMP	$\Sigma N_{\Theta S}$
SNTU	U	U	COMP	$\Sigma N_{\Theta U}$
SPENGY	U		BARIER	
SPG	U	U	DIMV	$\sin\phi_{Gi}$
SPHI	A	A	COMP	NOT USED
SPHIC	U	A	ADTNL	$\sin\phi_{C_i}$
SPHICI		U	COMP4	$\sin\phi_{C_i}$
SPHTP	U	U	COMP	$\sin\phi'_t$
SPSI	A	A	COMP	NOT USED
SPSTP	U	U	EINDEX	$\sin\Psi'_t$
SPYG	U	U	DIMV	$\sin\phi_{yGi}$
SRHOS		U	COMP5	$\Sigma\rho s_i \Delta t_n$
SSLIP		U	COMP4	$\Sigma(SLIP)_i \Delta t_n$
ST		U	DRIVE	$(\Delta S.i/U_T)$
STEPD		U	COMP4	

PROGRAM VARIABLE	R D	V D	COMMON BLOCK	ANALYTICAL VARIABLE OR EXPRESSION
STG	U	U	DIMV	$\sin\Theta_{Gi}$
STHETP	U	U	EINDEX	$\sin\Theta'_t$
STSØ2		U	DRIVE	$(\Delta S.i/U_T)^2/2$
STXG	U	U	DIMV	$\sin\Theta_{XGi}$
SUMM	U	U	COMP	ΣM
SWORK	U		BARIER	
SXR	U		BARIER	$(\Sigma X_R)_t$
SYR	U		BARIER	$(\Sigma Y_R)_t$
SZR	U		BARIER	$(\Sigma Z_R)_t$
T	U	U	INTG	t
TANPCL	U	U	NEWCRB	
TANPC1	U	U	COMPN	$\tan\phi_{c_1}$
TANPC2	U	U	COMPN	$\tan\phi_{c_2}$
TANPC3	U	U	NEWCRB	$\tan\phi_{c_3}$
TANPC4	U	U	NEWCRB	$\tan\phi_{c_4}$
TANPC5	U	U	NEWCRB	$\tan\phi_{c_5}$
TANPC6	U	U	NEWCRB	$\tan\phi_{c_6}$
TANTP	U	U	COMP	$\tan\Theta'_t$
TAU		U	COMP5	τ_i
TAUA		U	INPT5	τ_A
TAUF		U	DRIVI	τ
TAUO		U	INPT5	$(\tau_i)_o$
TB	U	U	INPT	TB
TCT		U	INPT5	CT
TCTEST		U	DRIVTT	
TE	U	U	INPT	TE
TEMPOR		U	DRIVE	

PROGRAM VARIABLE	R D	V D	COMMON BLOCK	ANALYTICAL VARIABLE OR EXPRESSION
TERM		U	COMP4	$\arctan \frac{Y_{Gi}}{/U_{Gi}/}$
TERMB		U	COMP4	$\phi_{C_i} - .6366\phi_{C_i}/\phi_{C_i}/$
TERMP		U	COMP4	$[\frac{V_{Gi}}{/U_{Gi}/} - \tan(\psi'_i \text{ sgn } U_{Gi}]^2$
TERMX		U	DRIVE	
TERMY		U	DRIVE	
TERM1	U	U	COMP	$Z_f + \delta_1 + h_1 \cos\gamma_{h_1}$
TERM2	U	U	COMP	$Z_f + \delta_2 + h_2 \cos\gamma_{h_2}$
TESTB		U	DRIVE	T_b
TESTBO		U	DRIVI	T_b
TESTR1		U	DRIVE	T_{R_1}
TESTR2		U	DRIVE	T_{R_2}
TESTS1		U	DRIVE	T_{S_1}
TESTS2		U	DRIVE	T_{S_2}
TESTT		U	DRIVI	
TF	U	U	INPT	T_F
TF02	U	U	COMP	$T_F/2$
TG61	U	U	COMP	$M_{UR}(\dot{\delta}_3 - \phi_R\dot{\phi}_R)$
THED	U	U	HEAD	TIRE TITLE
THESKD		U	DRIVE	Θ_c
THETAO	U	U	INPT	Θ_o
THETN	U	U	COMP	Θ'_n
THETT	U	U	COMP	Θ_t or Θ
THETTL	U	U	EINDEX	Θ_{t-1}
THETTP	U	U		Θ'_t
THGI	U	U	DIMV	Θ_{Gi}
THG1	U	U	COMP	
THG2	A	A	COMP	NOT USED

PROGRAM VARIABLE	R D	V D	COMMON BLOCK	ANALYTICAL VARIABLE OR EXPRESSION
THMAX	U	U	INPT	Θ_{max}
TI	U	A	DIMV	T_i
TIHI		A	COMP4	NOT USED
TIL		U	DRIVI	T_I
TIMR		A	INTR	NOT USED
TINCR	U	U	INPT	
TITE		U	DRIVE	$t-t_j-\tau$
TIZ	U	U	COMP	$M_{UF}[a^2 + (\frac{T_F^2}{2})] + M_{UR}b^2$
TIZ2	U	U	COMP	$M_{UR}\rho^2\dot{\phi}_R$
TJ		U	DRIVE	
TL		U	DRIVI	T_L
TLAMB		U	COMP5	$I_{D_j}\overline{AR}^2/(41_{W_j} + I_{D_j}\overline{AR}^2)$
TLF		U	INPT5	LF
TMT		U	DRIVE	$(T_I-T_L)/T_L$
TM4	U	U	COMP	$T_F M_{UF}/4$
TPATH		U	DRIVTT	
TPC		U	INPT5	P_C
TPD		U	DRIVE	
TPF	U	U	SUSCMP	$T_F\phi_F/2$
TPR	U	U	COMP	$T_R\phi_R/2$
TPRINT				
TQB		U	COMP5	$(TQ)_{Bi}$
TQD		U	COMP5	$(TQ)_{Di}$
TQE		U	COMP5	$(TQ)_E$
TQF	U	A	INPT	$\overline{TQ}_F$
TQFAC		A	COMP4	NOT USED
TQR	U	A	INPT	$\overline{TQ}_R$
TR	U	U	INPT	T_R
TRH	U	U	COMP	$R_W - h_i$

PROGRAM VARIABLE	R D	V D	COMMON BLOCK	ANALYTICAL VARIABLE OR EXPRESSION
TRO2	U	U	COMP	$T_R/2$
TRKIN		U	DRIVE	
TRPME		U	INPT5	RPME
TS	U	U	INPT	T_S
TSF	U	U	INSUS	T_{SF}
TSFØ2	U	U	SUSCMP	$T_{SF}/2$
TS02	U	U	COMP	$T_S/2$
TSTR10		U	DRIVI	T_{R_1}
TSTR20		U	DRIVI	T_{R_1}
TSTS10		U	DRIVI	T_{S_1}
TSTS20		U	DRIVI	T_{S_1}
TT		U	INPT5	
TTAU		U	INPT5	
TTEM		U	DRIVE	
TTPSIT		U	DRIVE	
TTR		U	INPT5	(TR)
TTS		U	INPT5	(TS)
TWOPI	U	U	EINDEX	2π
TWOPIR		U	COMP4	$1/(2\pi)$
TWOT		U	INPT5	WOT
TX	U	U	COMP	$X'_{GPi} - X'_i$
TY	U	U	COMP	$Y'_{GPi} - Y'_i$
TZ	U	U	COMP	$Z'_{GPi} - Z'_i$
TO	U	U	INPT	
T1	U	U	INPT	
T1PSI	U	U	COMPN	$T_{1\psi}$
T2PSI	U	U	COMPN	$T_{2\psi}$
U	U	U		u
UG	U	U	DIMV	u_{Gi}

PROGRAM VARIABLE	R D	V D	COMMON BLOCK	ANALYTICAL VARIABLE OR EXPRESSION
UGW		U	COMP5	u_{GW_i}
UI	U	U		u_i
UNP	U		BARIER	u'_n
UP		A	DRIVE	NOT USED
UPT	U		HARDPT	U'_{Ri}
UQ	U	U	COMP	uQ
UR	U	U	COMP	uR
URP	U		BARIER	u'_r
UT		U	DRIVE	u_T
UTMPH		U	DRIVE	U_T
UVWMIN	U	U	INPT	
UO	U	U	INPT	u_o
U1	U	U	ADTNL	u_1
U2	U	U	ADTNL	u_2
U3	U	U	ADTNL	u_3
U4	U	U	ADTNL	u_4
V	U	U		v
VAR	U	U	INTG	[y]
VARR		A	INTR	NOT USED
VDEF	U		BARIER	$Y'_{CPm} - (Y'_{BP})_t$
VECS		U	COMP5	$\sqrt{U_{G_1}^2 + Y_{G_i}^2}$
VG	U	U	DIMV	v_{Gi}
VGR12		U	DRIVI	VGR_{12}
VGR21		U	DRIVI	VGR_{21}
VGR23		U	DRIVI	VGR_{23}
VGR32		U	DRIVI	VGR_{32}
VGR34		U	DRIVI	VGR_{34}

PROGRAM VARIABLE	R D	V D	COMMON BLOCK	ANALYTICAL VARIABLE OR EXPRESSION
VGR43		U	DRIVI	VGR_{43}
VHED		U	HEAD	VEHICLE TITLE
VI	U	U		v_i
VL	U		BARIER	$\dot{\delta}_B - \epsilon_{n-1}$
VMAX	U		BARIER	δ_B
VNP	U		BARIER	v'_n
VP	U	U	COMP	vP
VPT	U		HARDPT	v'_{Ri}
VR	U	U	COMP	vR
VRP	U		BARIER	v'_r
VTAN	U		BARIER	VTAN
VO	U	U	INPT	v_o
V1	U	U	ADTNL	v_1
V2	U	U	ADTNL	v_2
V3	U	U	ADTNL	v_3
V4	U	U	ADTNL	v_4
W	U	U		w
WI	U	U		w_i
WNP	U		BARIER	w'_n
WP	U	U	COMP	wP
WPT	U		HARDPT	w'_{Ri}
WQ	U	U	COMP	wQ
WRP	U		BARIER	w'_r
WO	U	U	INPT	w_o
W1	U	U	ADTNL	w_1
W2	U	U	ADTNL	w_2
W3	U	U	ADTNL	w_3
W4	U	U	ADTNL	w_4

PROGRAM VARIABLE	R D	V D	COMMON BLOCK	ANALYTICAL VARIABLE OR EXPRESSION
X		U	DRIVE	
XB	U	U	INPT	X_B
XBB	U		BARIER	X_{BB}
XBT	U		BARIER	X_{BI}
XBDRY	U	U	INPT	X_{BDRY}
XBRAK		A	COMP4	NOT USED
XCP	U	U		X'_C
XCPBP	U		BARIER	X'_{CPB}
XCPN	U		BARIER	X_{CPn}
XCPNP	U		BARIER	X'_{CPn}
XCPTP	U		BARIER	X'_{CPT}
XCOP	U	U	INPT	X'_{CO}
XE	U	U	INPT	X_E
XF	U		BARIER	$(F_B)_{t-1}$
XGPP	U	U	DIMV	X'_{GPi}
XIF	U	U	INSUS	I_F
XIMPOR		U	DRIVI	WI_i
XINCR	U	U	INPT	X_{INCR}
XINDL	U	U	EINDEX	
XINDN	U	U	EINDEX	
XINPT	A		INPT2	NOT USED
XINPT5		A	INPT5	NOT USED
XINT		U	DRIVE	
XIPS	U	U	INPT1	I_ψ
XIR	U	U	INPT	I_R
XIX	U	U	INPT	I_X
XIXP	U	U	COMP	$(I'_X)_t$
XIXZ	U	U	INPT	I_{XZ}
XIXZP	U	U	COMP	$(I'_{XZ})_t$
XIY	U	U	INPT	I_Y

PROGRAM VARIABLE	R D	V D	COMMON BLOCK	ANALYTICAL VARIABLE OR EXPRESSION
XIYP	U	U	ADTNL	$(I'_Y)_t$
XIYZP	U	U	COMP	$(I'_{YZ})_t$
XIZ	U	U	INPT	I_Z
XIZP	U	U	COMP	$(I'_Z)_t$
XIZR	U	U	COMP	$I_Z + I_R$
XLAMF	U	U	INPT	λ_F
XLAMR	U	U	INPT	λ_R
XLAMT	U	U	TIRIN	λ_T
XLDP	A		BARIER	NOT USED
XLM1	U	U	DIMV	λ_{1i}
XLM2	U	U	DIMV	λ_{2i}
XLM3	U	U	DIMV	λ_{3i}
XM	A		INPT2	NOT USED
XMS	U	U	INPT	M_S
XMTF04	U	U	COMP	$T_F M_{UF}/4$
XMTR04	U	U	SUSCMP	$M_{UR} T_R/4$
XMTX	U		BARIER	
XMUR	U	U	INPT	M_{UF}
XMUF02	U	U	COMP	$M_{UF}/2$
XMUGI	U	U	COMPN	$AMUG_i$, AMU
XMUI	U	U	COMP4	μ_i
XMUM		U	INPT4	μ_{mi}
XMUMAT		U	INPT4	
XMUR	U	U	INPT	M_{UR}
XMURØ2	U	U	SUSCMP	$M_{UR}/2$
XMUXP		U	INPT4	μ_{XP}
XMUXS		U	INPT4	μ_{XS}
XMXPMT		U	INPT4	
XMXSMT		U	INPT4	
XNN	U		BARIER	x_N

PROGRAM VARIABLE	R D	V D	COMMON BLOCK	ANALYTICAL VARIABLE OR EXPRESSION
XP	U	U		x'_i
XPS	U	U	INPT1	$\overline{PT}$
XRI	U		BARIER	$(x_R)_i$
XSTI	U		BARSTR	X_{ST_i}
XSTIØ	U		BARSTR	X_{STi_0}
XSTIP	U		BARSTR	X'_{ST_i}
XTRA	A	A	ADTNL	NOT USED
XVF	U		INPT2	x_{VF}
XVP		U	DRIVE	X'_{VP_i}
XVR	U		INPT2	x_{VR}
XXFRCP		U	INPT4	
XXUGMU		U	INPT4	
XXX	U	U	COMP	
XXZGP5	U	U	INPT	
XX1	U	U	COMP	
XX2	U	U	COMP	
X1	U	U	INPT	x_1
X1P	U	U	DIMV	x'_1
X2	U	U	INPT	x_2
X2P	U	U	DIMV	x'_2
X3P	U	U	DIMV	x'_3
X4P	U	U	DIMV	x'_4
Y		U	DRIVE	
YB	U	U	INPT	Y_B
YBB	U		BARIER	y_{BB}
YBPT	U		BARIER	y'_{BT}
YBDRY	U	U	INPT	Y_{BDRY}
YḂPTP	U		BARIER	y'_{BPT}
YBPO	U		INPT2	y'_{Bo}
YBT	U		BARIER	y_{BT}

PROGRAM VARIABLE	R D	V D	COMMON BLOCK	ANALYTICAL VARIABLE OR EXPRESSION
YCIP	U	U		y'_{Ci}
YCLP	U	U	NEWCRB	
YCMP	U	U	NEWCRB	
YCP	U	U		y'_{C}
YCPBP	U		BARIER	y'_{CPB}
YCPMP	U		BARIER	y'_{CPm}
YCPN	U		BARIER	y_{CPn}
YCPNP	U		BARIER	y'_{CPn}
YCPTP	U		BARIER	y'_{CPT}
YCOP	U	U	INPT	y'_{Co}
YC1P	U	U	INPT1	y'_{C1}
YC2P	U	U	INPT1	y'_{C2}
YC3P	U	U	NEWCRB	y'_{c3}
YC4P	U	U	NEWCRB	y'_{c4}
YC5P	U	U	NEWCRB	y'_{c5}
YC6P	U	U	NEWCRB	y'_{c6}
YE	U	U	INPT	Y_{E}
YGPPP	U	U	DIVM	y'_{GPi}
YINCR	U	U	INPT	Y_{INCR}
YNN	U		BARIER	y_{n}
YP	U	U		y'_{i}
YRI	U		BARIER	$(y_R)_i$
YSTI	U		BARSTR	y_{STi}
YSTIØ	U		BARSTR	y_{STi0}
YSTIP	U		BARSTR	y'_{STi}
YSTIPØ	U		BARSTR	y'_{STi0}
YTRANS		U	DRIVI	
YV	U		INPT2	y_{V}
YVP		U	DRIVE	y'_{VPi}
YYY	U	U	COMP	
YYZGP5	U	U	INPT	
YY1	U	U	COMP	
YY2	U	U	COMP	
Y1	U	U	INPT	y_1
Y1P	U	U	DIMV	y'_1
Y2	U	U	INPT	y_2
Y2P	U	U	DIMV	y'_2
Y3P	U	U	DIMV	y'_3
Y4P	U	U	DIMV	y'_4
ZBB	U		BARIER	Z_{BB}
ZBBP	U		INPT2	z'_{BB}
ZBT	U		BARIER	z_{BT}
ZBTP	U		INPT2	z'_{BT}
ZCLP	U	U	NEWCRB	
ZCMP	U	U	NEWCRB	
ZCP	U	U		z'_{C}
ZCPBP	U		BARIER	z_{CPB}
ZCPN	U		BARIER	z_{CPn}
ZCPNP	U		BARIER	z'_{CPn}
ZCPTP	U		BARIER	z'_{CPT}
ZCOP	U	U	INPT	z'_{CO}
ZC2P	U	U	INPT1	z'_{C2}
ZC3P	U	U	NEWCRB	Z'_{C3}
ZC4P	U	U	NEWCRB	Z'_{C4}
ZC5P	U	U	NEWCRB	Z'_{C5}
ZC6P	U	U	NEWCRB	Z'_{C6}
ZETAB		U	INPT5	ζ_B
ZETA3	A	A	COMP	NOT USED
ZETA3D	A	A	COMP	NOT USED

PROGRAM VARIABLE	R D	V D	COMMON BLOCK	ANALYTICAL VARIABLE OR EXPRESSION
ZETA4	A	A	COMP	NOT USED
ZETA4D	A	A	COMP	NOT USED
ZF	U	U	INPT	Z_F
ZFD1	U	U	SUSCMP	$Z_F+\delta_1$
ZFD1RF	U	U	SUSCMP	$Z_F+\delta_1+\rho_F$
ZFD12	U	U	COMP	$Z_F + (\delta_1 + \delta_2)/2$
ZFD2	U	U	SUSCMP	$Z_F+\delta_2$
ZFD3R	U	U	COMP	$Z_F + \rho + \delta_3$
ZFØ	U	U	SUSCMP	$Z_F+\rho_F$
ZGP	U	U	INPT	Z'_G
ZGPP	U	U	DIMV	Z'_{GPi}
ZNN	U	U	BARIER	z_n
ZP	U	U		z'_i
ZPGI	U	U	DIMV	z'_{Gi}
ZPR	U	U	COMP	$z_F + \rho$
ZR	U	U	INPT	z_R
ZRD3	U	U	COMP	$z_R + \delta_3$
ZRD3R	U	U	COMP	$z_R + \delta_3 + \rho$
ZRD34	U	U	SUSCMP	$Z_R+(\delta_3+\delta_4)/2$
ZRD4	U	U	SUSCMP	$Z_R+\delta_4$
ZRI	U		BARIER	$(z_R)_i$
ZRO	U	U	COMP	$z_R + \rho$
ZSTI	U		BARSTR	Z_{STi}
ZSTIØ	U		BARSTR	Z_{STi_0}
ZSTIP	U		BARSTR	Z'_{STi}
ZVB	U		INPT2	z_{VB}
ZVT	U		INPT2	z_{VT}
ZZ1	U	U	COMP	
ZZZ	U	U	COMP	
Z1	U	U	INPT	z_1
Z1P	U	U	DIMV	z'_1
Z2	U	U	INPT	z_2
Z2P	U	U	DIMV	z'_2
Z3P	U	U	DIMV	z'_3
Z4P	U	U	DIMV	z'_4

3. PROGRAM DOCUMENTATION

3.1 Roadside Design Version

A description of each computational subroutine of the HVOSM-RD2 is provided in this section. Included is a brief description of the purpose of the subroutine, a description of the linkages to the rest of the program in the forms of subroutine called, calling arguments, common blocks appearing, variables within the common blocks that are the result of a computation, and, in the subroutine size. Also included is a description of the computational procedure employed either in the form of a verbal listing of the computational steps or an annotated flowchart illustrating the logical sequence of computations. Since this part of the subroutine description is intended to illustrate the procedure, it does not always illustrate each individual line of coding. When a detailed investigation of the coding is required, the computational procedure should be used in conjunction with a subroutine listing.

An overall program block diagram is shown in Figure 3.1-1, a matrix of common blocks appearing in each subroutine in Figure 3.1-2, and a matrix of subroutine calls in Figure 3.1-3.

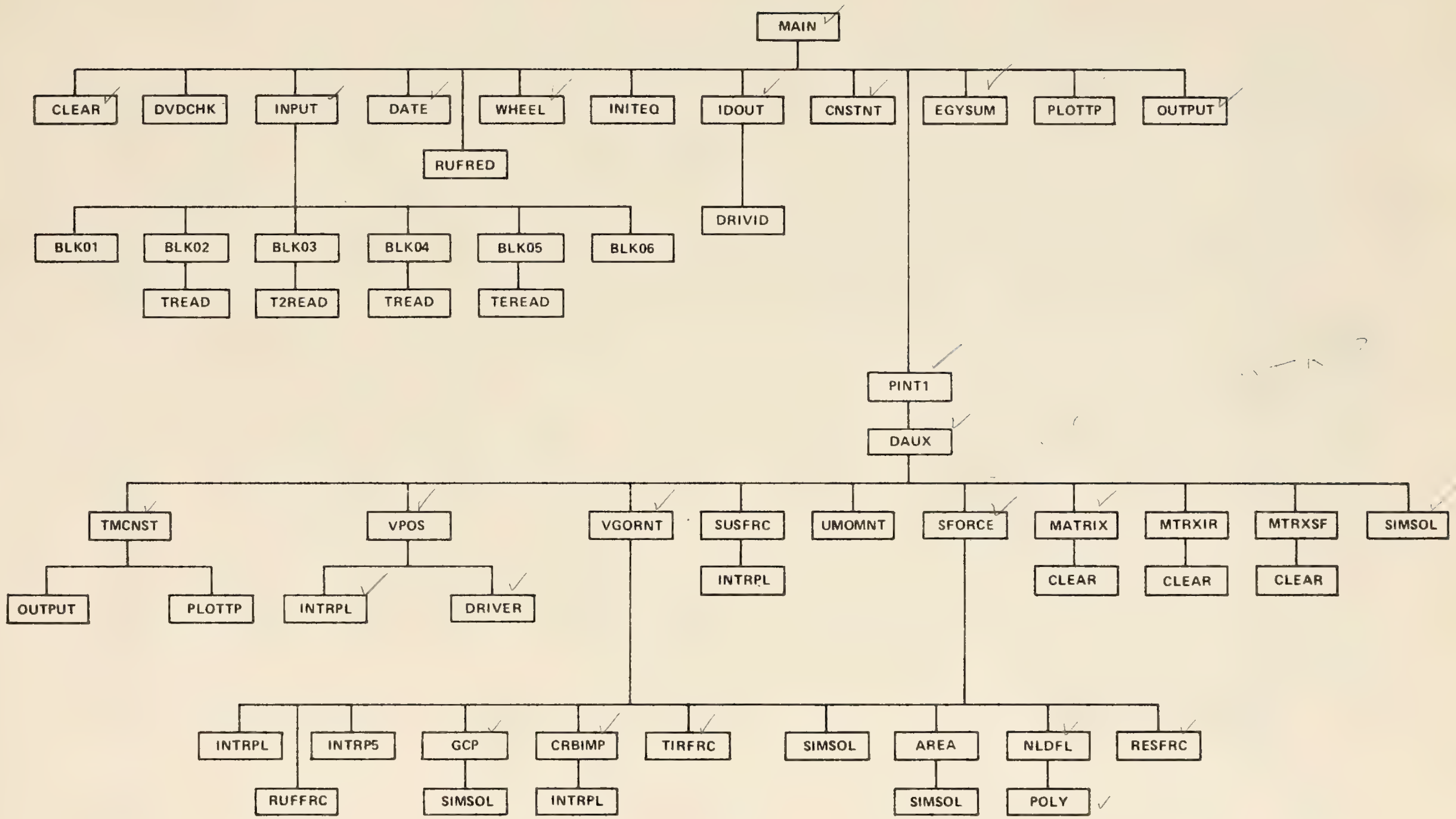


Figure 3.1-1 HVOSM-RD2 OVERALL PROGRAM BLOCK DIAGRAM

COMMON BLOCK

SUBROUTINE	HEAD	INPT	INPT1	INTG	DIMV	COMP	COMPN	EINDEX	ADTNL	INPT2	INPT3	TIRIN	BARIER	APTABL	INSUS	SUSCMP	NEWCRB	BARSTR	HARDPT	RUFNES	DRIVTT	DRIVI	NSTOP
MAIN	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●
AREA					●								●										
BLKO1	●	●	●							●					●		●						
BLKO2	●	●	●							●	●			●	●			●					
BLKO3	●		●									●											
BLKO4	●	●																					
BLKO5	●	●	●							●							●			●			
BLKO6	●	●	●												●								
CLEAR																							
CNSTNT	●	●	●	●		●	●	●		●		●	●		●	●	●						
CRBIMP			●	●	●	●	●					●					●						
DATE																							
DAUX		●	●	●	●	●	●		●	●					●	●					●		●
DRIVER																							
DRIVID																							
DVDCHK																							
EGYSUM										●			●										
GCP					●	●						●											
IDOUT	●	●	●			●				●	●	●		●	●		●	●					
INITEQ																							
INPUT																							
INTRPL																							
INTRP5		●			●	●	●					●											
MATRIX		●		●	●	●			●														
MTRXIR		●		●	●	●			●							●							
MTRXSF		●		●	●	●			●						●	●							
NLDFL				●						●			●										
OUTPUT	●	●		●	●	●	●		●						●	●		●					
PINT1																							
PLOTTP		●		●	●	●	●					●											
POLY																							
RESFRC				●	●	●				●			●					●	●				
RUFRED																							
RUFFRC			●		●	●	●					●								●			
SIMSOL																							
SFORCE				●	●	●	●			●			●					●	●				
SUSFRC		●		●	●	●			●		●			●	●	●							
TEREAD		●																					
TIRFRC					●	●	●		●			●											
TMCNST		●		●		●		●							●	●							
TREAD																							
T2READ																							
UMOMNT		●			●	●									●	●							
VGORNT		●	●	●	●	●	●		●			●			●	●	●			●			
VPOS		●	●	●	●	●	●		●						●	●							
WHEEL																							

Figure 3.1-2 HVOSM-RD2 COMMON BLOCK ALLOCATIONS

CALLED ROUTINE

CALLING ROUTINE	MAIN	AREA	BLKO1	BLKO2	BLKO3	BLKO4	BLKO5	BLKO6	CLEAR	CNSTNT	CRBIMP	DATE	DAUX	DRIVER	DRIVID	DVDCHK	EGYSUM	GCP	IDOUT	INITEQ	INPUT	INTRPL	INTRP5
MAIN									●	●		●				●	●		●	●	●		
AREA																							
BLKO1																							
BLKO2																							
BLKO3																							
BLKO4																							
BLKO5																							
BLKO6																							
CLEAR																							
CNSTNT																							
CRBIMP																						●	
DATE																							
DAUX																							
DRIVER																							
DRIVID																							
DVDCHK																							
EGYSUM																							
GCP																							
IDOUT															●								
INITEQ																							
INPUT			●	●	●	●	●	●															
INTRPL																							
INTRP5																							
MATRIX									●														
MTRXIR									●														
MTRXSF									●														
NLDFL																							
OUTPUT																							
PINT1													●										
PLOTTP																							
POLY																							
RESFRC																							
RUFFRC																						●	
RUFRED																							
SIMSOL																							
SFORCE		●																					
SUSFRC																						●	
TEREAD																							
TIRFRC																							
TMCNST																							
TREAD																							
T2READ																							
UMOMNT																							
VGORNT											●							●					●
VPOS														●								●	
WHEEL																							

CALLING ROUTINE	MATRIX	MTRXIR	MTRXSF	NLDFL	OUTPUT	PINT1	PLOTTP	POLY	RESFRC	RUFFRC	RUFRED	SIMSOL	SFORCE	SUSFRC	TEREAD	TIRFRC	TMCNST	TREAD	T2READ	UMOMNT	VGORNT	VPOS	WHEEL
MAIN					●	●	●				●												●
AREA												●											
BLKO1																							
BLKO2																		●					
BLKO3																			●				
BLKO4																		●					
BLKO5															●								
BLKO6																							
CLEAR																							
CNSTNT																							
CRBIMP																							
DATE																							
DAUX	●	●	●									●	●	●			●			●	●	●	
DRIVER																							
DRIVID																							
DVDCHK																							
EGYSUM																							
GCP												●											
IDOUT																							
INITEQ																							
INPUT																							
INTRPL																							
INTRP5																							
MATRIX																							
MTRXIR																							
MTRXSF																							
NLDFL								●															
OUTPUT																							
PINT1																							
PLOTTP																							
POLY																							
RESFRC																							
RUFFRC																							
RUFRED																							
SIMSOL																							
SFORCE				●					●			●											
SUSFRC																							
TEREAD																							
TIRFRC																							
TMCNST					●		●																
TREAD																							
T2READ																							
UMOMNT																							
VGORNT										●						●							
VPOS																							
WHEEL																							

Figure 3.1-3 HVOSM-RD2 MATRIX OF SUBROUTINE CALLS

3.1.1 HVOSM-RD2 Subroutine Documentation

1. MAIN ROUTINE

a. Purpose:

1. Clear selected COMMON blocks
2. Obtain input and print input
3. Program initialization
4. Control computation of constants
5. Control the integration loop
6. Control abnormal program stops
7. Control indexing of coordinate system
8. Control integration step size for curb and sprung mass impact
9. Control output

b. Common Blocks Required:

HEAD, INPT, INPT1, INTG, DIMV, COMP, COMPN, EINDEX, ADTNL, INPT2, INPT3, TIRIN, BARIER, APTABL, INSUS, SUSCMP, NEWCRB, BARSTR, DRIVTT, DRIVI, NSTOP, HARDPT, RUFNES

c. Subroutines Required:

CLEAR, CNSTNT, DATE, DVDCHK, EGYSUM, IDOUT, INITEQ, INPUT, OUTPUT, PINT1, PLOTTP, WHEEL, RUFRED

d. Arguments:

None

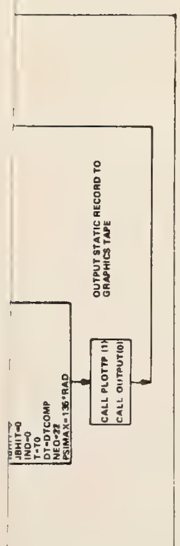
e. Common Variables Claculated:

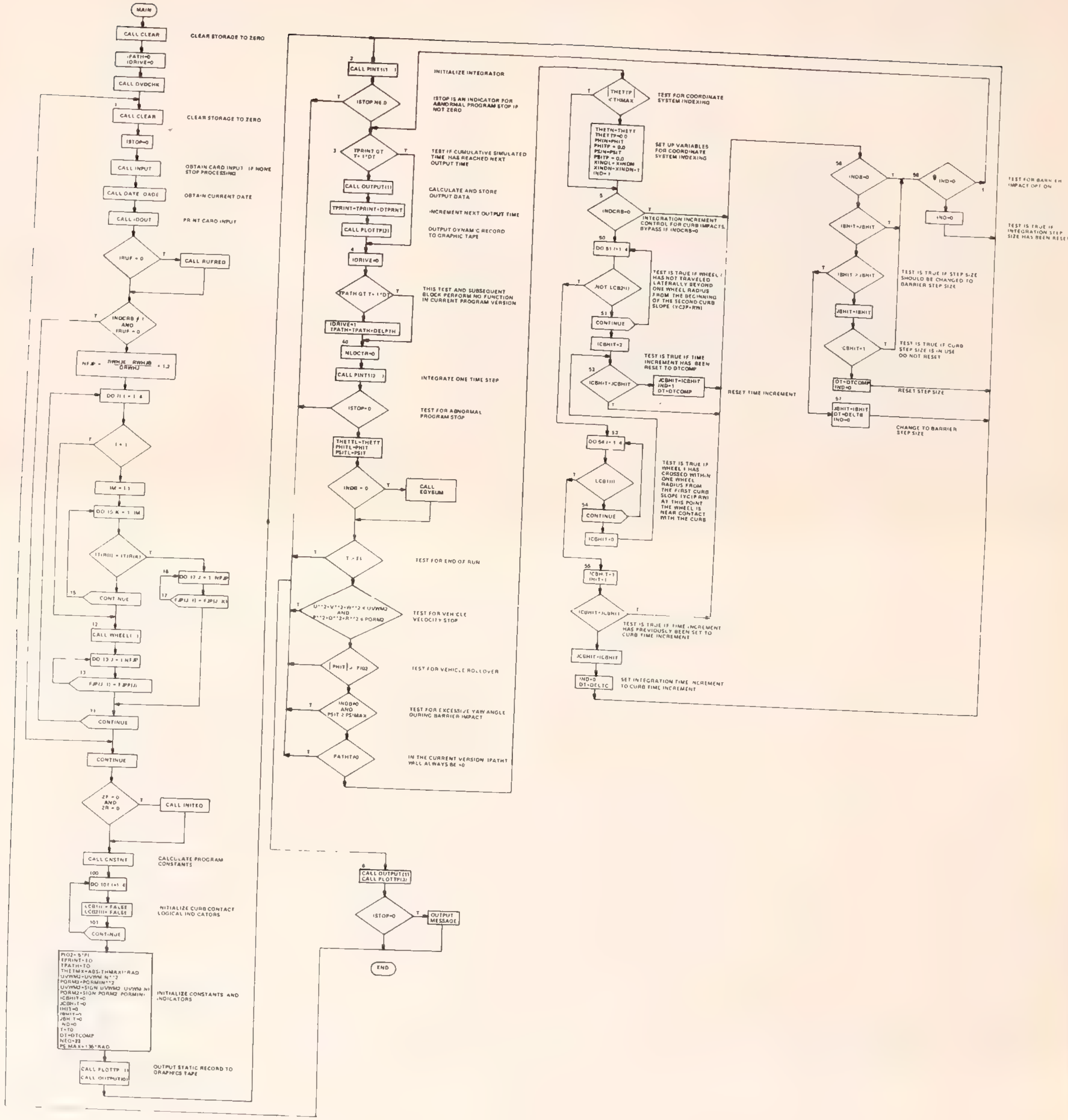
T, DT, FJP, NEQ, ZGP, DADE, DELG, IHIT, IRUF, LCB1, LCB2, NEND, NFJP, PHIN, PIO2, PSIN, DGMAX, ILOAD, JBHIT, PHITL, THETN, TPATH, UVWM2, XINDL, XINDN, ICBHIT, IDRIVE, IPATHT, JCBHIT, NLDCTR, PSIMAX, THETTL

f. Size:

$D42)_{16} = 3394)_{10}$ bytes

g. Computational Procedure:


JBHIT=0
IND=0
T=T0
DT=DTCOMP
NEQ=22
PSIMAX=136*RAD
CALL PLOTTP (1)
CALL OUTPUT(0)
OUTPUT STATIC RECORD TO
GRAPHICS TAPE


MAIN
CALL CLEAR
CLEAR STORAGE TO ZERO
IPATH=0
IDRIVE=0
CALL OVDCHK
CALL CLEAR
CLEAR STORAGE TO ZERO
ISTOP=0
CALL INPUT
OBTAIN CARD INPUT IF NONE STOP PROCESSING
CALL DATE
OBTAIN CURRENT DATE
CALL IDOUT
PRINT CARD INPUT
IRUF = 0
CALL RUFRED
CONTINUE
ZP = 0 AND ZR = 0
CALL INITEO
CALL CNSTNT
CALCULATE PROGRAM CONSTANTS
NITIALIZE CURB CONTACT LOGICAL INDICATORS
INITIALIZE CONSTANTS AND INDICATORS
OUTPUT STATIC RECORD TO GRAPHICS TAPE
CALL PINT1(1)
INITIALIZE INTEGRATOR
ISTOP NE 0
ISTOP IS AN INDICATOR FOR ABNORMAL PROGRAM STOP IF NOT ZERO
TEST IF CUMULATIVE SIMULATED TIME HAS REACHED NEXT OUTPUT TIME
CALL OUTPUT(1)
CALCULATE AND STORE OUTPUT DATA
TPRINT=TPRINT+DTPRNT
INCREMENT NEXT OUTPUT TIME
OUTPUT DYNAMIC RECORD TO GRAPHIC TAPE
IDRIVE=0
THIS TEST AND SUBSEQUENT BLOCK PERFORM NO FUNCTION IN CURRENT PROGRAM VERSION
INTEGRATE ONE TIME STEP
ISTOP=0
TEST FOR ABNORMAL PROGRAM STOP
CALL EQYSUM
TEST FOR END OF RUN
TEST FOR VEHICLE VELOCITY STOP
TEST FOR VEHICLE ROLLOVER
TEST FOR EXCESSIVE YAW ANGLE DURING BARRIER IMPACT
IN THE CURRENT VERSION IPATH1 WILL ALWAYS BE =0
CALL OUTPUT(1)
CALL PLOTTP(3)
ISTOP=0
OUTPUT MESSAGE
END
TEST FOR COORDINATE SYSTEM INDEXING
SET UP VARIABLES FOR COORDINATE SYSTEM INDEXING
INDCRB=0
INTEGRATION INCREMENT CONTROL FOR CURB IMPACTS. BYPASS IF INDCRB=0
CONTINUE
TEST IS TRUE IF TIME INCREMENT HAS BEEN RESET TO DTCOMP
RESET TIME INCREMENT
SET INTEGRATION TIME INCREMENT TO CURB TIME INCREMENT
TEST IS TRUE IF TIME INCREMENT HAS PREVIOUSLY BEEN SET TO CURB TIME INCREMENT
TEST FOR BARRIER IMPACT OPTION
TEST IS TRUE IF INTEGRATION STEP SIZE HAS BEEN RESET
TEST IS TRUE IF STEP SIZE SHOULD BE CHANGED TO BARRIER STEP SIZE
TEST IS TRUE IF CURB STEP SIZE IS IN USE DO NOT RESET
RESET STEP SIZE
CHANGE TO BARRIER STEP SIZE

?. SUBROUTINE AREA

a. Purpose:

1. Compute the intersection area between the vehicle and barrier
2. Compute the projection of the intersection volume centroid on the interface

b. Common Blocks Required:

DIMV, BARIER

c. Subroutines Required:

SIMSOL

d. Arguments:

None

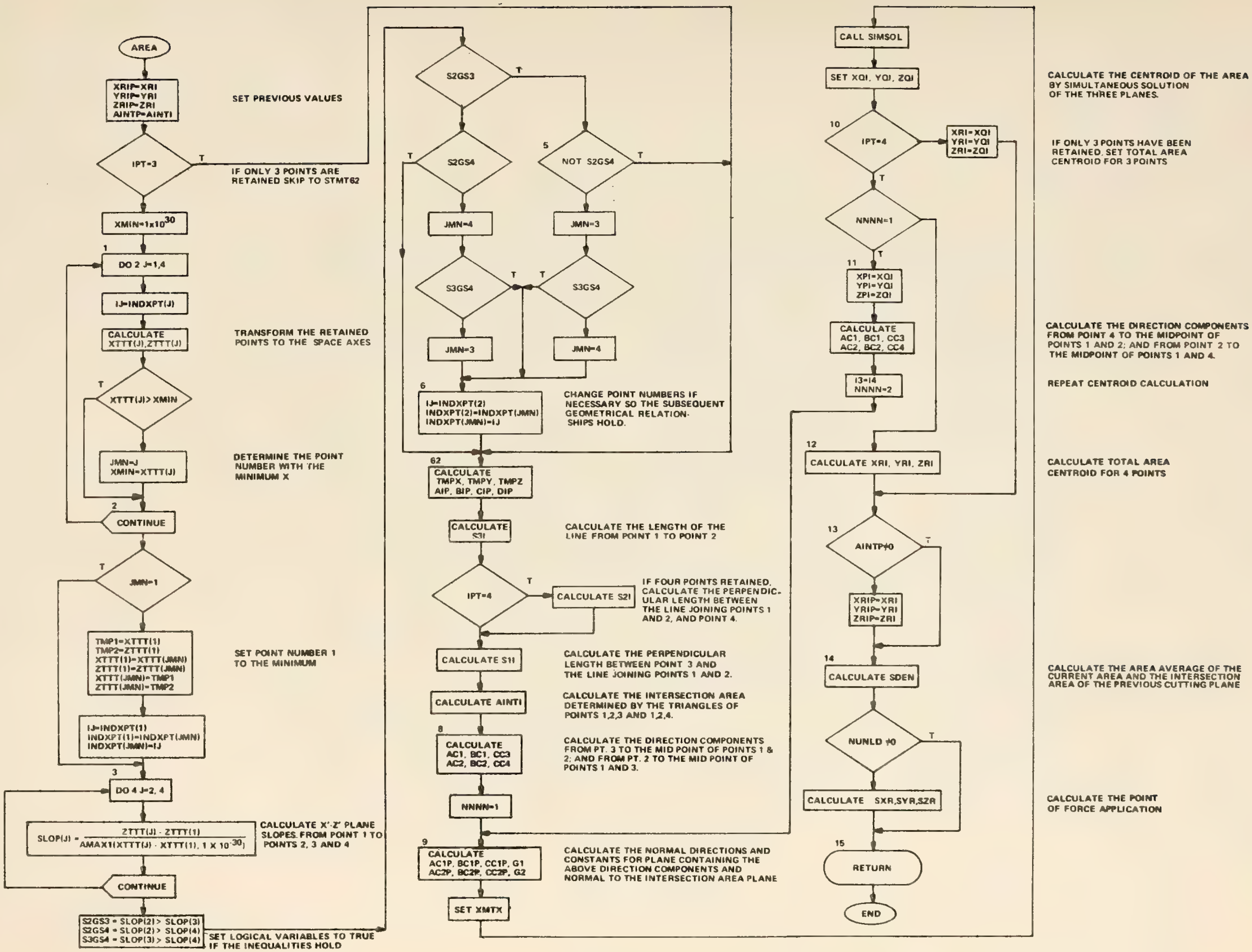
e. Common Variables Calculated:

I3, SRX, SRY, SRZ, XRI, YRI, ZRI, SDEN, XMTX, AINTI, AINTP, INDXPT

f. Size:

$9F6)_{16} = 2550)_{10}$ bytes

g. Computational Procedure:


AREA
XRIP=XRI
YRIP=YRI
ZRIP=ZRI
AINTP=AINTI
SET PREVIOUS VALUES
IPT=3
T
IF ONLY 3 POINTS ARE RETAINED SKIP TO STMT62
XMIN=1x10^30
1
DO 2 J=1,4
IJ=INDXPT(J)
CALCULATE XTTT(J),ZTTT(J)
TRANSFORM THE RETAINED POINTS TO THE SPACE AXES
XTTT(J)> XMIN
JMN=J
XMIN=XTTT(J)
DETERMINE THE POINT NUMBER WITH THE MINIMUM X
2
CONTINUE
JMN=1
TMP1=XTTT(1)
TMP2=ZTTT(1)
XTTT(1)=XTTT(JMN)
ZTTT(1)=ZTTT(JMN)
XTTT(JMN)=TMP1
ZTTT(JMN)=TMP2
SET POINT NUMBER 1 TO THE MINIMUM
IJ=INDXPT(1)
INDXPT(1)=INDXPT(JMN)
INDXPT(JMN)=IJ
3
DO 4 J=2, 4
SLOP(J) = (ZTTT(J) - ZTTT(1)) / AMAX1(XTTT(J) - XTTT(1), 1 X 10^-30)
CALCULATE X'-Z' PLANE SLOPES FROM POINT 1 TO POINTS 2, 3 AND 4
CONTINUE
S2GS3 = SLOP(2) > SLOP(3)
S2GS4 = SLOP(2) > SLOP(4)
S3GS4 = SLOP(3) > SLOP(4)
SET LOGICAL VARIABLES TO TRUE IF THE INEQUALITIES HOLD
S2GS3
S2GS4
5
NOT S2GS4
JMN=4
JMN=3
S3GS4
S3GS4
JMN=3
JMN=4
6
IJ=INDXPT(2)
INDXPT(2)=INDXPT(JMN)
INDXPT(JMN)=IJ
CHANGE POINT NUMBERS IF NECESSARY SO THE SUBSEQUENT GEOMETRICAL RELATIONSHIPS HOLD.
62
CALCULATE TMPX, TMPY, TMPZ AIP, BIP, CIP, DIP
CALCULATE S3I
CALCULATE THE LENGTH OF THE LINE FROM POINT 1 TO POINT 2
IPT=4
CALCULATE S2I
IF FOUR POINTS RETAINED, CALCULATE THE PERPENDICULAR LENGTH BETWEEN THE LINE JOINING POINTS 1 AND 2, AND POINT 4.
CALCULATE S1I
CALCULATE THE PERPENDICULAR LENGTH BETWEEN POINT 3 AND THE LINE JOINING POINTS 1 AND 2.
CALCULATE AINTI
CALCULATE THE INTERSECTION AREA DETERMINED BY THE TRIANGLES OF POINTS 1,2,3 AND 1,2,4.
8
CALCULATE AC1, BC1, CC3 AC2, BC2, CC4
CALCULATE THE DIRECTION COMPONENTS FROM PT. 3 TO THE MID POINT OF POINTS 1 & 2; AND FROM PT. 2 TO THE MID POINT OF POINTS 1 AND 3.
NNNN=1
9
CALCULATE AC1P, BC1P, CC1P, G1 AC2P, BC2P, CC2P, G2
CALCULATE THE NORMAL DIRECTIONS AND CONSTANTS FOR PLANE CONTAINING THE ABOVE DIRECTION COMPONENTS AND NORMAL TO THE INTERSECTION AREA PLANE
SET XMTX
CALL SIMSOL
SET XQI, YQI, ZQI
CALCULATE THE CENTROID OF THE AREA BY SIMULTANEOUS SOLUTION OF THE THREE PLANES.
10
IPT=4
XRI=XQI
YRI=YQI
ZRI=ZQI
IF ONLY 3 POINTS HAVE BEEN RETAINED, SET TOTAL AREA CENTROID FOR 3 POINTS
NNNN=1
11
XPI=XQI
YPI=YQI
ZPI=ZQI
CALCULATE AC1, BC1, CC3 AC2, BC2, CC4
CALCULATE THE DIRECTION COMPONENTS FROM POINT 4 TO THE MIDPOINT OF POINTS 1 AND 2; AND FROM POINT 2 TO THE MIDPOINT OF POINTS 1 AND 4.
I3=I4
NNNN=2
REPEAT CENTROID CALCULATION
12
CALCULATE XRI, YRI, ZRI
CALCULATE TOTAL AREA CENTROID FOR 4 POINTS
13
AINTP≠0
XRIP=XRI
YRIP=YRI
ZRIP=ZRI
14
CALCULATE SDEN
CALCULATE THE AREA AVERAGE OF THE CURRENT AREA AND THE INTERSECTION AREA OF THE PREVIOUS CUTTING PLANE
NUNLD ≠0
CALCULATE SXR,SYR,SZR
CALCULATE THE POINT OF FORCE APPLICATION
15
RETURN
END

3. SUBROUTINE BLK01

a. Purpose:

1. Assign input values of simulation control data

b. Common Blocks Required:

HEAD, INPT, INPT1, INPT2, INSUS, NEWCRB

c. Subroutines Required:

None

d. Arguments:

NBLK - Input data block number
NBCRD - Card number within the block
NSEQ - Table sequence number
NCARD - Card number
DUM - Array containing input values read in Subroutine INPUT to be assigned to the appropriate variable names within this subroutine
NERR - Error indicator

e. Common Variables Calculated:

EM, T0, T1, AAA, BET, HED, EBAR, HMAX, HMIN, INDB, ISUS, MODE, DELTB, DELTC, NPAGE, THMAX, DTCOMP, DTPRNT, INDCRB, NCRBSL, PQRMIN, UVWMIN

f. Size:

$480)_{16} = 1152)_{10}$ bytes

4. SUBROUTINE BLK02

a. Purpose:

1. Assign input values of simulation vehicle data

b. Common Blocks Required:

HEAD, INPT, INPT1, INPT2, INPT3, APTABL, INSUS, BARSTR

c. Subroutine Required:

TREAD

d. Arguments:

NBLK - Input data block number
NBCRD - Card number within the block
NSEQ - Table sequence number
NCARD - Card number
DUM - Array containing input values read in Subroutine INPUT to be assigned to the appropriate variable names within this subroutine
NERR - Error indicator

e. Common Variables Calculated:

A, B, G, CF, CR, RF, RR, TF, TR, TS, X1, X2, YV, Y1, Y2, ZF, ZR, Z1, Z2, AKF, AKR, AKV, APF, APR, CFP, CRP, RHO, TSF, XIF, XIR, XIX, XIY, XIZ, XMS, XPS, XVF, XVR, ZVB, ZVT, AKDS, AKFC, AKFE, AKPS, AKRC, AKRE, AKRS, AKST, CPSP, DDEL, DELB, DELE, DTHF, DTHR, EPSF, EPSR, NAPF, NAPR, NDEL, PHIC, RHOF, VHED, XIPS, XIXZ, XMUF, XMUR, AKDS1, AKDS2, AKDS3, AKFCP, AKFEP, AKRCP, AKREP, DAPFB, DAPFE, DAPRB, DAPRE, DDAPF, DDAPR, EPSPS, IAPFR, NDTHF, NDTHR, NPAGE, OMGPS, PHIRC, XLAMF, XLAMR, XSTIO, YSTIO, ZSTIO, OMEGFC, OMEGFE, OMEGRC, OMEGRE

f. Size:

$906)_{16} = 2310)_{10}$ bytes

5. SUBROUTINE BLK03

a. Purpose:

1. Assign input values of simulation tire data

b. Common Blocks Required:

HEAD, INPT1, TIRIN

c. Subroutines Required:

T2READ

d. Arguments:

NBLK - Input data block number
NBCRD - Card number within the block
NSEQ - Table sequence number
NCARD - Card number
DUM - Array containing input values read in Subroutine INPUT to be assigned to the appropriate variable names within this subroutine
NERR - Error indicator

e. Common Variables Calculated:

A0, A1, A2, A3, A4, RW, AKT, AMU, ITIR, SIGT, THED, DRWHJ, OMEGT, RWHJE, XLAMT

f. Size:

$45A)_{16} = 1114)_{10}$ bytes

6. SUBROUTINE BLK04

a. Purpose:

1. Assign input values of simulation vehicle control data

b. Common Blocks Required:

HEAD, INPT

c. Subroutines Required:

TREAD

d. Arguments:

NBLK - Input data block number
NBCRD - Card number within the block
NSEQ - Table sequence number
NCARD - Card number
DUM - Array containing input values read in Subroutine INPUT to be assigned to the appropriate variable names within this subroutine
NERR - Error indicator

e. Common Variables Calculated:

TQF, TQR, CHED, PSIF, NPAGE, NTBL1, NTBL2, NTBL3, TINCR

f. Size:

$3AC)_{16} = 940)_{10}$ bytes

7. SUBROUTINE BLK05

a. Purpose:

1. Assign input values of simulation terrain, curb and barrier data

b. Common Blocks Required:

HEAD, INPT, INPT1, INPT2, NEWCRB, RUFNES

c. Subroutines Required:

TEREAD

d. Arguments:

NBLK - Input data block number
NBCRD - Card number within the block
NSEQ - Table sequence number
NCARD - Card number
DUM - Array containing input values read in Subroutine INPUT to be assigned to the appropriate variable names within this subroutine
NERR - Error indicator

e. Common Variables Calculated:

NX, NY, XB, XE, YB, YE, NBX, NBY, NZ5, SET, AMUB, AMUC, AMUG, CONS, DELG, EPSB, EPSV, GHED, IRUF, NEND, SIGR, YBP0, YC1P, YC2P, YC3P, YC4P, YC5P, YC6P, ZBBP, ZBTP, ZC2P, ZC3P, ZC4P, ZC5P, ZC6P, DGMAX, EPSP, NPAGE, NZTAB, PHIC1, PHIC2, PHIC3, PHIC4, PHIC5, PHIC6, XINCR, YINCR, DELYBP

f. Size:

$746)_{16} = 1862)_{10}$ bytes

8. SUBROUTINE BLK06

a. Purpose:

1. Assign input values of simulation initial conditions

b. Common Blocks Required:

HEAD, INPT, INPT1, INSUS

c. Subroutines Required:

None

d. Arguments:

NBLK - Input data block number
NBCRD - Card number within the block
NSEQ - Table sequence number
NCARD - Card number
DUM - Array containing input values read in Subroutine INPUT to be assigned to the appropriate variable names within this subroutine
NERR - Error indicator

e. Common Variables Calculated:

P0, Q0, R0, U0, V0, W0, PHI0, PSI0, SHED, XCOP, YCOP, ZCOP, DEL10, DEL20, DEL30, DEL40, PHIF0, PHIR0, DEL10D, DEL20D, DEL30D, DEL40D, PHIF0D, PHIR0D, PSIFD0, PSIFI0, THETA0

f. Size:

$318)_{16} = 792)_{10}$ bytes

9. SUBROUTINE CLEAR(A,B)

a. Purpose:

1. To set a block of storage to zero

b. Common Blocks Required:

None

c. Subroutines Required:

None

d. Arguments:

A - beginning address to be cleared
B - end of the full-word address to be cleared

e. Common Variables Calculated:

None

f. Size:

$182)_{16} = 386)_{10}$ bytes

10. SUBROUTINE CNSTNT

a. Purpose:

1. Evaluate program constants
2. Initialize dependent variables and derivatives to input initial conditions

b. Common Blocks Required:

HEAD, INPT, INPT1, INTG, COMP, COMPN, EINDEX, INPT2, TIRIN, BARIER, INSUS, SUSCMP, NEWCRB

c. Subroutines Required:

None

d. Arguments:

None

e. Common Variables Calculated:

P, Q, R, U, V, W, AA1, AA2, A12, A23, BB1, BB2, CC1, CC2, RR1, RR2, RTF, RTR, TIZ, TM4, XCP, YCP, ZCP, ZF0, ZPR, ZR0, AMUF, A234, BMUR, DEL1, DEL2, DEL3, DEL4, GAM1, PHIF, PHIN, PHIR, PI02, PI04, PSIN, RFTF, RH02, RRTR, RRTS, SUMM, TF02, TR02, TS02, XCPN, YBPT, YCLP, YCPN, YC3P, YC4P, YC5P, YC6P, ZCPN, ZC3P, ZC4P, ZC5P, ZC6P, DEL1D, DEL2D, DEL3D, DEL4D, PHIFD, PHIRD, PHITL, PHITP, PSIFI, PSITL, PSITP, RHMR2, RHOF2, YBPTP, A02APB, AXMF02, B02APB, BROMUR, BXMR02, OMT2A2, OMT2M1, PHICLR, PHIC1R, PHIC2R, PHIC3R, PHIC4R, PHIC5R, PHIC6R, PSIFID, RF2MFI, RHFMUF, RHF2MF, RHMR2I, RHOMUR, TANPCL, TANPC1, TANPC2, TANPC3, TANPC4, TANPC5, TANPC6, THETTL, THETTP, XMTF04, XMTR04, XMUF02, XMUR02

f. Size:

$A2E)_{16} = 2606)_{10}$ bytes

g. Computational Procedure:

1. Compute program constants
2. Initialize dependent variables converting degrees to radians
3. Initialize XINDT = 10, if THETN or PHIN are not zero for use in MAIN and TMCNST to control coordinate system indexing

11. SUBROUTINE CRBIMP(I)

a. Purpose:

1. Determine the radial tire force and equivalent ground contact point when a tire is in contact with a curb

b. Common Blocks Required:

INPT1, DIMV, COMP, COMPN, INTG, TIRIN, NEWCRB

c. Subroutines Required:

INTRPL

d. Arguments:

The argument I indicates the wheel number for which calculations are made

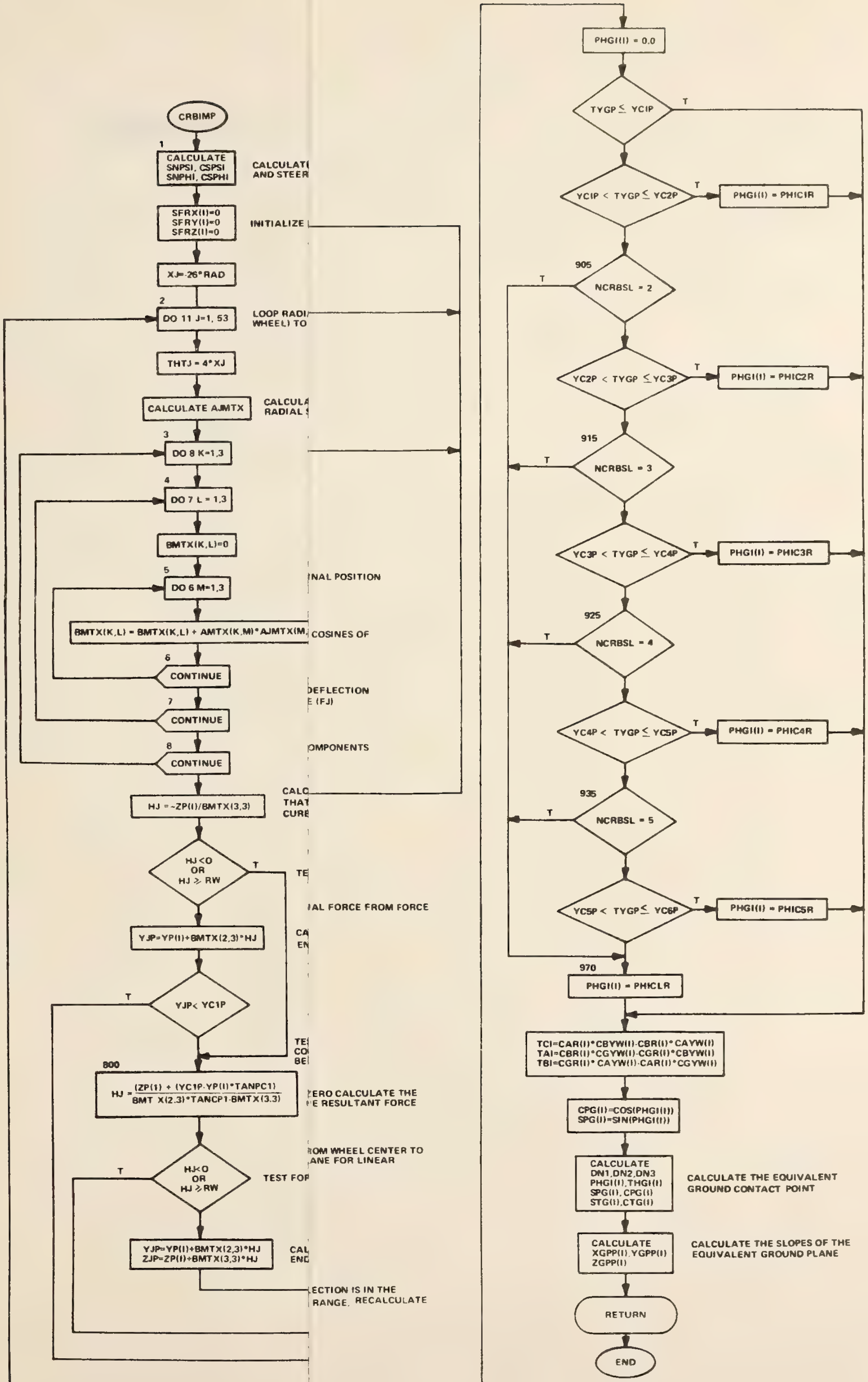
e. Common Variables Calculated:

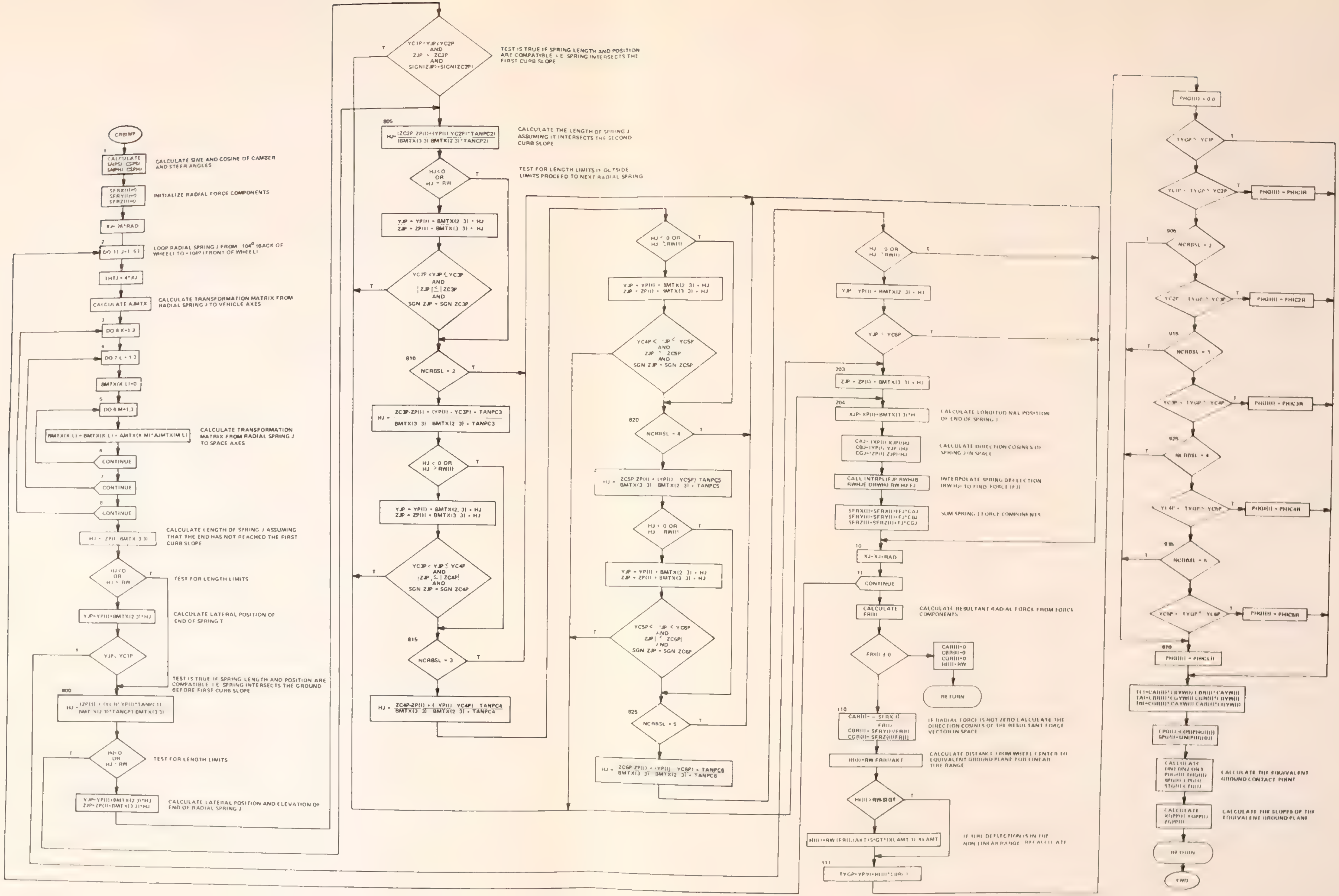
FR, HI, RW, CAR, CBR, CGR, CPG, CTG, SPG, STG, BMTX, PHGI, SFRX, SFRY, SFRZ, THGI, XGPP, YGPP, ZGPP, AJMTX

f. Size:

$F32)_{16} = 3890)_{10}$ bytes

g. Computational Procedure:


CRBIMP
CALCULATE SNPSI, CSPSI SNPHI, CSPHI
SFRX(I)=0 SFRY(I)=0 SFRZ(I)=0
INITIALIZE
XJ=-26*RAD
DO 11 J=1, 53
THTJ = 4*XJ
CALCULATE AJMTX
DO 8 K=1,3
DO 7 L = 1,3
BMTX(K,L)=0
DO 6 M=1,3
CONTINUE
CONTINUE
CONTINUE
HJ = -ZP(I)/BMTX(3,3)
HJ<0 OR HJ ≥ RW
YJP=YP(I)+BMTX(2,3)*HJ
YJP< YC1P
800
HJ = (ZP(1) + (YC1P-YP(I)*TANPC1) / BMT X(2,3)*TANCP1-BMTX(3,3)
HJ<0 OR HJ ≥ RW
YJP=YP(I)+BMTX(2,3)*HJ
ZJP=ZP(I)+BMTX(3,3)*HJ
PHGI(I) = 0.0
TYGP ≤ YCIP
YCIP < TYGP ≤ YC2P
PHGI(I) = PHICIR
905
NCRBSL = 2
YC2P < TYGP ≤ YC3P
PHGI(I) = PHIC2R
915
NCRBSL = 3
YC3P < TYGP ≤ YC4P
PHGI(I) = PHIC3R
925
NCRBSL = 4
YC4P < TYGP ≤ YC5P
PHGI(I) = PHIC4R
935
NCRBSL = 5
YC5P < TYGP ≤ YC6P
PHGI(I) = PHIC5R
970
PHGI(I) = PHICLR
TCI=CAR(I)*CBYW(I)-CBR(I)*CAYW(I)
TAI=CBR(I)*CGYW(I)-CGR(I)*CBYW(I)
TBI=CGR(I)*CAYW(I)-CAR(I)*CGYW(I)
CPG(I)=COS(PHGI(I))
SPG(I)=SIN(PHGI(I))
CALCULATE DN1,DN2,DN3 PHGI(I),THGI(I) SPG(I),CPG(I) STG(I),CTG(I)
CALCULATE THE EQUIVALENT GROUND CONTACT POINT
CALCULATE XGPP(I),YGPP(I) ZGPP(I)
CALCULATE THE SLOPES OF THE EQUIVALENT GROUND PLANE
RETURN
END



CRBIMP
CALCULATE SINE AND COSINE OF CAMBER AND STEER ANGLES
SFRX(I)=0
SFRY(I)=0
SFRZ(I)=0
INITIALIZE RADIAL FORCE COMPONENTS
LOOP RADIAL SPRING J FROM -104° (BACK OF WHEEL) TO +104° (FRONT OF WHEEL)
DO 11 J=1 53
THTJ = 4*XJ
CALCULATE AJMTX
CALCULATE TRANSFORMATION MATRIX FROM RADIAL SPRING J TO VEHICLE AXES
DO 8 K=1,3
DO 7 L = 1,3
BMTX(K,L)=0
DO 6 M=1,3
CALCULATE TRANSFORMATION MATRIX FROM RADIAL SPRING J TO SPACE AXES
CONTINUE
CONTINUE
CONTINUE
CALCULATE LENGTH OF SPRING J ASSUMING THAT THE END HAS NOT REACHED THE FIRST CURB SLOPE
TEST FOR LENGTH LIMITS
CALCULATE LATERAL POSITION OF END OF SPRING J
TEST IS TRUE IF SPRING LENGTH AND POSITION ARE COMPATIBLE I.E. SPRING INTERSECTS THE GROUND BEFORE FIRST CURB SLOPE
TEST FOR LENGTH LIMITS
CALCULATE LATERAL POSITION AND ELEVATION OF END OF RADIAL SPRING J
TEST IS TRUE IF SPRING LENGTH AND POSITION ARE COMPATIBLE I.E. SPRING INTERSECTS THE FIRST CURB SLOPE
CALCULATE THE LENGTH OF SPRING J ASSUMING IT INTERSECTS THE SECOND CURB SLOPE
TEST FOR LENGTH LIMITS IF OUTSIDE LIMITS PROCEED TO NEXT RADIAL SPRING
YJP = YP(I) + BMTX(2 3) * HJ
ZJP = ZP(I) + BMTX(3 3) * HJ
NCRBSL = 2
NCRBSL = 3
NCRBSL = 4
NCRBSL = 5
CALCULATE LONGITUDINAL POSITION OF END OF SPRING J
CALCULATE DIRECTION COSINES OF SPRING J IN SPACE
INTERPOLATE SPRING DEFLECTION (RW-HJ) TO FIND FORCE (FJ)
SUM SPRING J FORCE COMPONENTS
XJ=XJ+RAD
CONTINUE
CALCULATE FR(I)
CALCULATE RESULTANT RADIAL FORCE FROM FORCE COMPONENTS
CAR(I)=0
CBR(I)=0
CGR(I)=0
H(I)=RW
RETURN
IF RADIAL FORCE IS NOT ZERO CALCULATE THE DIRECTION COSINES OF THE RESULTANT FORCE VECTOR IN SPACE
CALCULATE DISTANCE FROM WHEEL CENTER TO EQUIVALENT GROUND PLANE FOR LINEAR TIRE RANGE
IF TIRE DEFLECTION IS IN THE NON LINEAR RANGE RECALCULATE
PHG(I) = 0.0
PHG(I) = PHIC1R
PHG(I) = PHIC2R
PHG(I) = PHIC3R
PHG(I) = PHIC4R
PHG(I) = PHIC5R
PHG(I) = PHIC6R
CALCULATE THE EQUIVALENT GROUND CONTACT POINT
CALCULATE THE SLOPES OF THE EQUIVALENT GROUND PLANE
RETURN
END

SUBROUTINE DATE

a. Purpose:

1. Return the calender date in 8 byte form, e.g., 23MAR'68

b. Common Blocks Required:

None

c. Subroutines Required:

None

d. Arguments:

DADE - Array into which the date is loaded

e. Common Variables Calculated:

None

f. Size:

$D6)_{16} = 214)_{10}$ bytes

g. Procedure:

This subroutine is written in IBM S/360 Assembler Language

13. SUBROUTINE DAUX

a. Purpose:

1. Evaluate the derivatives of the dependent variables for subsequent integration in PINT1

b. Common Blocks Required:

INPT, INPT1, INTG, DIMV, COMP, COMPN, ADTNL, INPT2, INSUS, SUSCMP, NSTOP

c. Subroutines Required:

VPOS, VGORNT, TMCNST, MATRIX, SIMSOL, MTRXIR, MTRXSF, SFORCE, SUSFRC, UMOMNT

d. Arguments:

None

e. Common Variables Calculated:

DP, DQ, DR, DU, DV, DW, DXCP, DYCP, DZCP, GAM2, GAM3, GAM4, GAM5, GAM6, GAM7, GAM8, GAM9, XIYP, XIXP, XIZP, DDEL1, DDEL2, DDEL3, DDEL4, DMATX, DPHIF, DPHIR, T1PSI, T2PSI, XIXZP, XIYZP, DDEL1D, DDEL2D, DDEL3D, DDEL4D, DDPSFI, DPHIFD, DPHIRD, DPHITP, DPSIFI, DPSITP, DTHTTP

f. Size:

$AD4)_{16} = 2772)_{10}$ bytes

g. Computational Procedure:

1. Test for abnormal program stop (ISTOP $\neq$ 0) and return if indicated.
2. Calculate time dependent variables by calling subroutine TMCNST.
3. Calculate time dependent inertial terms: XIXP, XIYP, XIZP, XIXZP, XIYZP, GAM2, GAM3, GAM4, GAM5, GAM6, GAM7, GAM8, GAM9. Note that these variables differ with the suspension option in effect, thus branching to the appropriate set of calculation occurs based in ISUS.
4. Call subroutines VPOS and VGORNT to determine the position and orientation of the vehicle.
5. Calculate suspension displacements and velocities depending on suspension option.
6. Call subroutines SUSFRC to calculate suspension forces, and UMOMNT to calculate moments acting on the sprung mass and solid axles (if being used).

7. If the barrier option is being used (INDB≠0) call subroutine SFORCE to obtain impact forces and moments.
8. Depending on the suspension option in effect, call either subroutine MATRIX, MATRXIR or MTRXSF to evaluate the inertial matrix and forcing function stored in the array DMATX.
9. Call subroutine SIMSOL to solve the 10x10 set of simultaneous equations of motion for the 10 derivatives of the dependent variables.
10. Set the solution vector from SIMSOL, DMATX(I,11), to the appropriate variable names and set the remaining 10 derivatives depending on suspension option.
11. Compute the derivatives of the steering degree-of-freedom if in effect as indicated by either INDCRB<0 or IHIT=1 and INDCRB>0.

14. SUBROUTINE DRIVER(SA,SADOT, ISA)

a. Purpose:

1. DRIVER is a dummy subroutine included to provide linkages for an automatic steering algorithm and provides no other function in this program version.

b. Common Blocks Required:

None

c. Subroutines Required:

None

d. Arguments:

SA - front wheel steer angle
SADOT - front wheel steer angle velocity
ISA - driver option indicator

e. Common Variables Calculated:

None

f. Size:

$E0)_{16} = 224)_{10}$ bytes

g. Computational Procedure:

1. This subroutine sets the driver indicator argument (ISA) to zero insuring this option is not used.

15. SUBROUTINE DRIVID

a. Purpose:

1. DRIVID is a dummy subroutine to provide linkages in order to print automatic steering control inputs. It provides no function in this program version.

b. Common Blocks Required:

None

c. Subroutines Required:

None

d. Arguments:

None

e. Common Variables Calculated:

None

f. Size:

$A4)_{16} = 164)_{10}$ bytes

16. SUBROUTINE DVDCHK

a. Purpose:

1. This subroutine processes interuptions caused by arithmetic instructions

b. Common Blocks Required:

None

c. Subroutines Required:

None

d. Arguments:

None

e. Common Variables Calculated:

None

f. Size:

$452)_{16} = 1108)_{10}$ bytes

g. Procedure:

1. A call to DVDCHK processes the following interuptions:

    1. fixed point divide exception
    2. exponent overflow exception
    3. exponent underflow exception
    4. floating point divide exception

    This subroutine is written in IBM Assembler Language. The services provided are also given by extended FORTRAN error handling.

17. SUBROUTINE EGYSUM

a. Purpose:

1. Calculate energy absorbed by the vehicle and barrier during a barrier impact
2. Set previous values of some barrier impact variables

b. Common Blocks Required:

INPT2, BARIER

c. Subroutines Required:

None

d. Arguments:

None

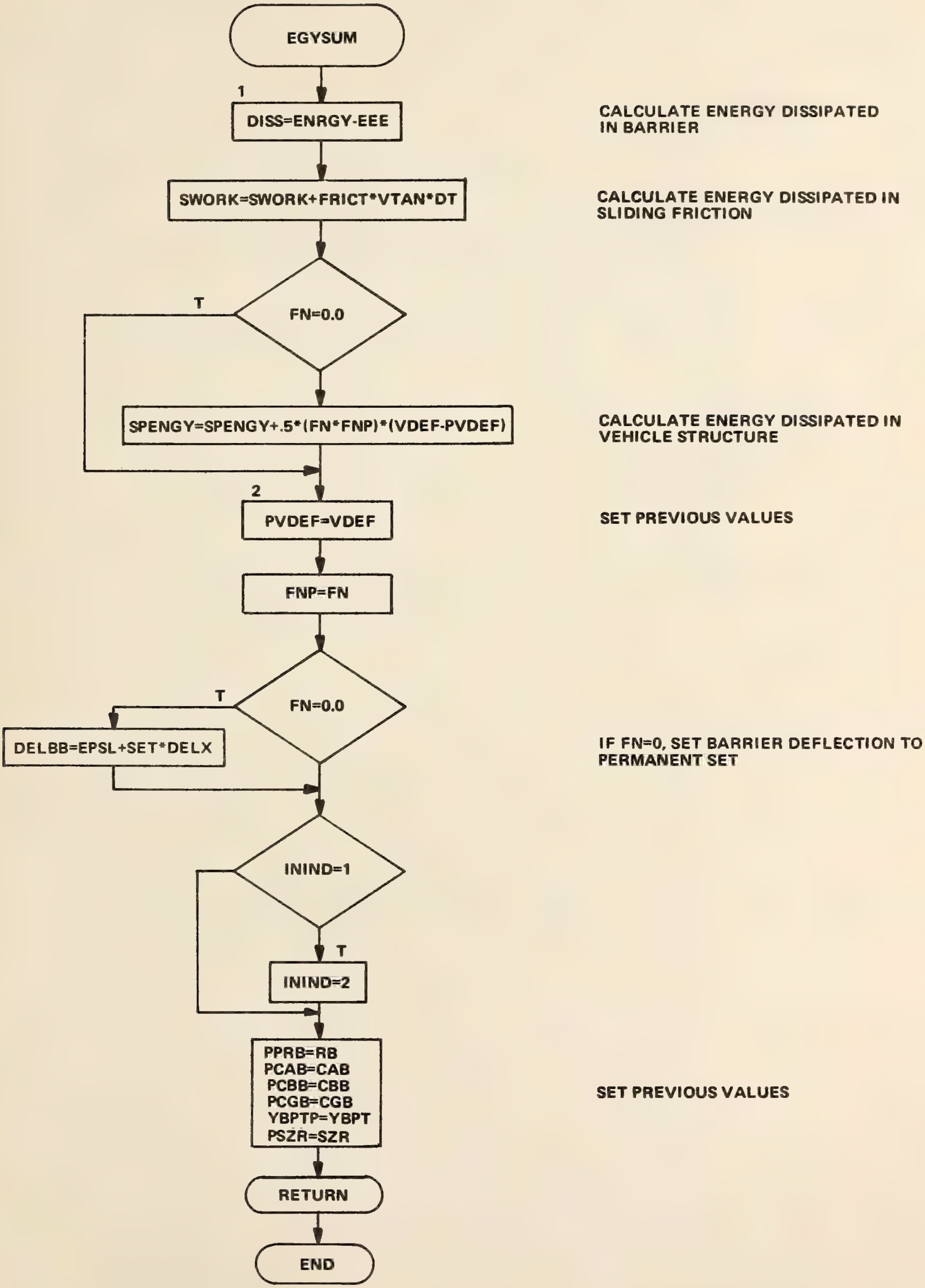
e. Common Variables Calculated:

FNP, DISS, PCAB, PCBB, PCGB, PPRB, PSZR, DELBB, ININD, PVDEF, SWORK, YBPTP, DELBBP, SPENGY

f. Size:

$18E)_{16} = 398)_{10}$ bytes

g. Computational Procedure:


EGYSUM
1
DISS=ENRGY-EEE
CALCULATE ENERGY DISSIPATED IN BARRIER
SWORK=SWORK+FRICT*VTAN*DT
CALCULATE ENERGY DISSIPATED IN SLIDING FRICTION
T
FN=0.0
SPENGY=SPENGY+.5*(FN*FNP)*(VDEF-PVDEF)
CALCULATE ENERGY DISSIPATED IN VEHICLE STRUCTURE
2
PVDEF=VDEF
SET PREVIOUS VALUES
FNP=FN
T
FN=0.0
DELBB=EPSL+SET*DELX
IF FN=0, SET BARRIER DEFLECTION TO PERMANENT SET
ININD=1
T
ININD=2
PPRB=RB
PCAB=CAB
PCBB=CBB
PCGB=CGB
YBPTP=YBPT
PSZR=SZR
SET PREVIOUS VALUES
RETURN
END

18. SUBROUTINE GCP(I)

a. Purpose:

1. Compute the coordinates of the tire ground contact point in space
2. Compute the rolling radius of the tire
3. Compute the direction and magnitude of the tire radial force

b. Common Blocks Required:

DIMV, COMP, TIRIN

c. Subroutines Required:

SIMSOL

d. Arguments:

The argument I indicates the wheel number for which calculations are made

e. Common Variables Calculated:

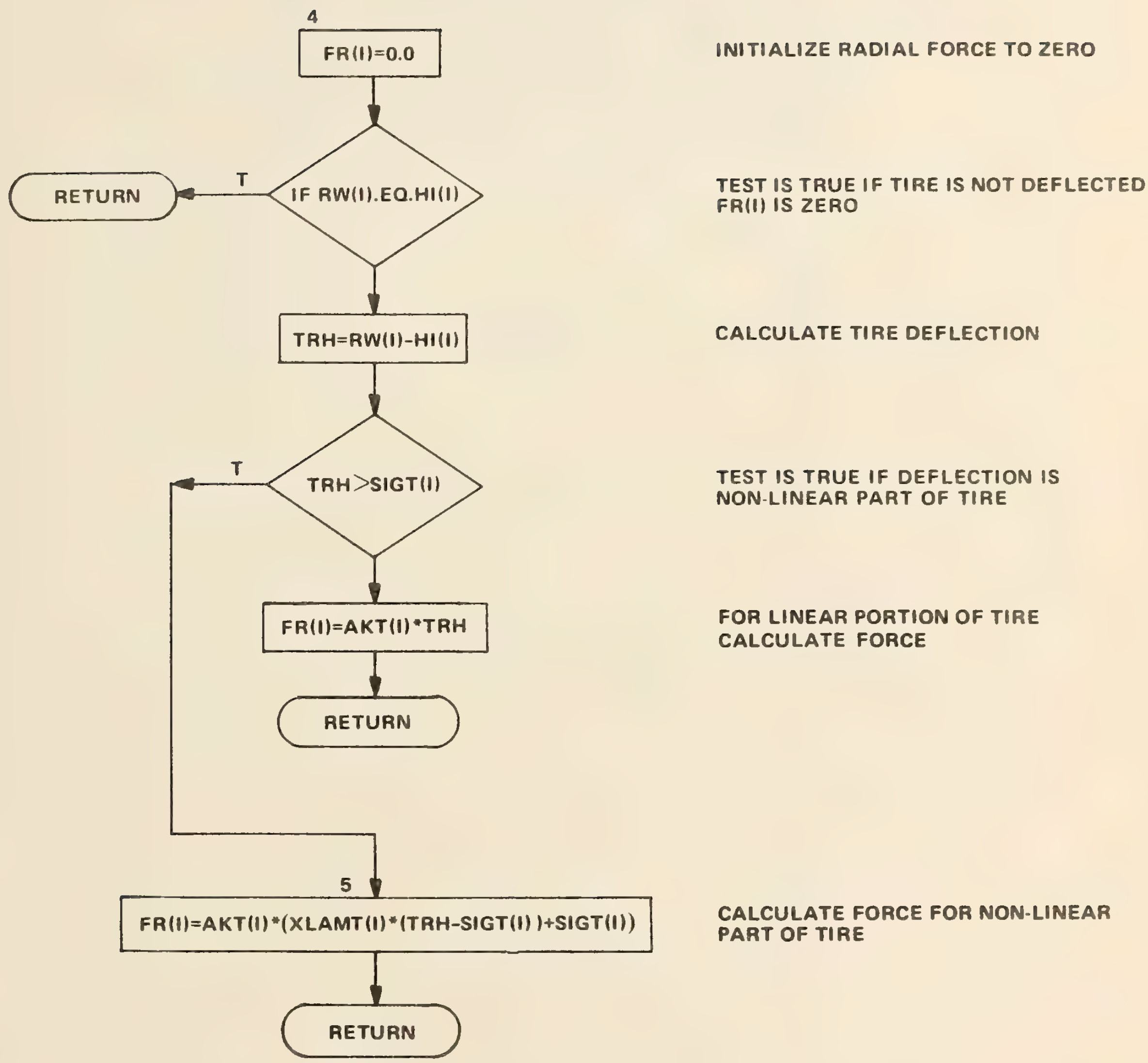
FR, HI, TX, TY, TZ, CAR, CBR, CGR, TRH, CMTX, XGPP, XLM1, XLM2, XLM3, YGPP, ZGPP, DELTA

f. Size:

$36C)_{16} = 876)_{10}$ bytes

g. Computational Procedure:

1. Calculate the coordinates of the ground contact point by simultaneous solution of the intersection of three planes: the wheel plane (normal direction CAYW(I), CBYW(I), CGYW(I)); the ground plane (normal direction CAGZ(I), CBGZ(I), CGGZ(I); and a plane perpendicular to both passing through the wheel center (normal direction D1(I), D2(I), D3(I)). The simultaneous solution is performed by SIMSOL with the CMTX array containing the above direction cosines and the target array (XLM1(I), XLM2(I), XLM3(I)) contained in the fourth column of CMTX. The solution is returned in the fourth column of CMTX and set to the coordinates of the ground contact point (XGPP(I), YGPP(I), ZGPP(I)).
2. Calculate the distance between the wheel center and ground contact point, DELTA(I).
3. Calculate the direction cosines of the line of action of the tire radial force with respect to the space axes (CAR(I), CBR(I), CGR(I)).
4. Determine the rolling radius, HI(I).
5. Calculate the radial tire force, FR(I), as shown:


4
FR(I)=0.0
INITIALIZE RADIAL FORCE TO ZERO
RETURN
T
IF RW(I).EQ.HI(I)
TEST IS TRUE IF TIRE IS NOT DEFLECTED FR(I) IS ZERO
TRH=RW(I)-HI(I)
CALCULATE TIRE DEFLECTION
T
TRH>SIGT(I)
TEST IS TRUE IF DEFLECTION IS NON-LINEAR PART OF TIRE
FR(I)=AKT(I)*TRH
FOR LINEAR PORTION OF TIRE CALCULATE FORCE
RETURN
5
FR(I)=AKT(I)*(XLAMT(I)*(TRH-SIGT(I))+SIGT(I))
CALCULATE FORCE FOR NON-LINEAR PART OF TIRE
RETURN

19. SUBROUTINE IDOUT

a. Purpose:

1. Print input values with units and headings

b. Common Blocks Required:

HEAD, INPT, INPT1, COMP, INPT2, INPT3, APTABL, TIRIN, INSUS, NEWCRB, BARSTR

c. Subroutines Required:

DRIVID

d. Arguments:

None

e. Common Variables Calculated:

None

f. Size:

$47D0)_{16}$ = $18384)_{10}$ bytes

20. SUBROUTINE INITEQ

a. Purpose:

1. To perform calculations to situate the vehicle in initial vertical equilibrium on flat, level terrain

b. Common Blocks Required:

INPT, COMP, DIMV, COMPN, INSUS, TIRIN

c. Subroutines Required:

None

d. Arguments:

None

e. Common Variables Calculated:

FR, HI, ZF, ZR

f. Size:

$324)_{16} = 804)_{10}$ bytes

g. Computational Procedure:

If ZF and ZR are input as zero, this subroutine calculates these variables based on the requirement for initial vertical equilibrium of the vehicle. Also calculated are tire radial forces and rolling radii.

21. SUBROUTINE INPUT

a. Purpose:

1. Obtain card input
2. Print card images

b. Common Blocks Required:

None

c. Subroutines Required:

BLK01, BLK02, BLK03, BLK04, BLK05, BLK06

d. Arguments:

None

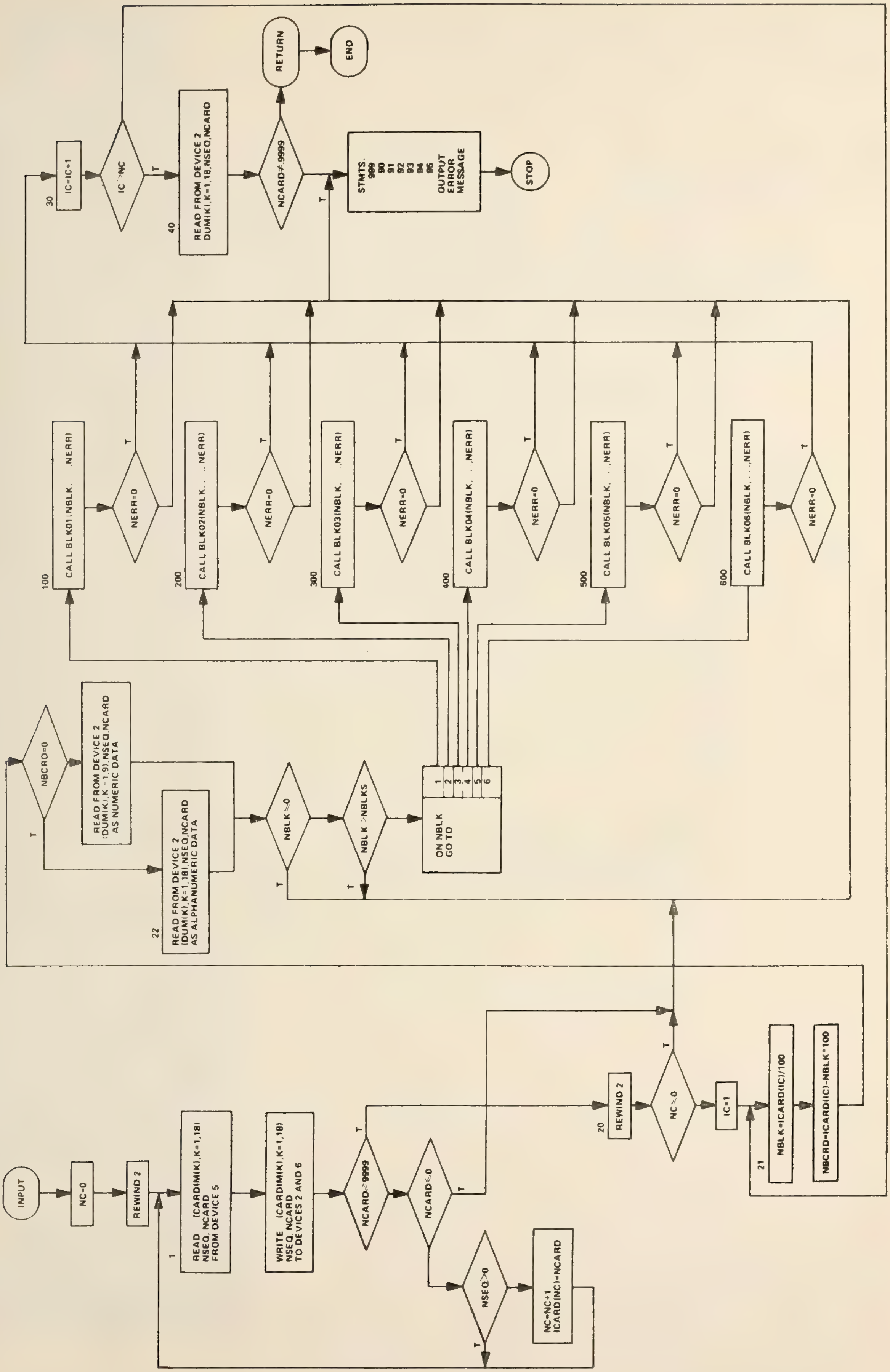
e. Common Variables Calculated:

None

f. Size:

$D5E)_{16} = 3422)_{10}$ bytes

g. Computational Procedure:



INPUT
NC=0
REWIND 2
1
READ ICARD(K), K=1,18) NSEQ, NCARD FROM DEVICE 5
WRITE ICARD(K), K=1,18) NSEQ, NCARD TO DEVICES 2 AND 6
NCARD≠9999
NCARD≤0
NSEQ>0
NC=NC+1 ICARD(NC)=NCARD
T
20
REWIND 2
NC≤0
IC=1
21
NBLK=ICARD(IC)/100
NBCRD=ICARD(IC)-NBLK*100
NBCRD=0
READ FROM DEVICE 2 (DUM(K), K=1,9),NSEQ,NCARD AS NUMERIC DATA
22
READ FROM DEVICE 2 (DUM(K),K=1,18),NSEQ,NCARD AS ALPHANUMERIC DATA
NBLK≤0
NBLK>NBLKS
ON NBLK GO TO
1
2
3
4
5
6
100
CALL BLK01(NBLK, . . ,NERR)
200
CALL BLK02(NBLK, . . ,NERR)
300
CALL BLK03(NBLK, . . ,NERR)
400
CALL BLK04(NBLK, . . ,NERR)
500
CALL BLK05(NBLK, . . ,NERR)
600
CALL BLK06(NBLK, . . ,NERR)
NERR=0
30
IC=IC+1
IC>NC
40
READ FROM DEVICE 2 DUM(K),K=1,18,NSEQ,NCARD
NCARD≠9999
RETURN
END
STMTS. 999 90 91 92 93 94 95
OUTPUT ERROR MESSAGE
STOP

22. SUBROUTINE INTRPL

a. Purpose

1. To obtain a quadratic interpolation of a one-dimensional table

b. Common Blocks Required:

None

c, Subroutines Required:

None

d. Arguments:

TABLE - one-dimensional array of data
XMIN - minimum abscissa value
XMAX - maximum abscissa value
DX - abscissa increment
X - abscissa value at which ordinate is desired
Y - ordinate of X

e. Common Variables Calculated:

None

f. Size:

$4A2)_{16} = 1186)_{10}$ bytes

g. Procedure:

1. Quadratic interpolation of the values of TABLE at X
2, ENTRY INTRPC also includes the additional argument SLOPE which is calculated as $\frac{d(TABLE)}{dx}$ at X

23. SUBROUTINE INTRP5(INDX)

a. Purpose:

1. Calculate the elevation and slopes under the wheel indicated by the argument INDX.
2. Set the nominal friction coefficient according to the table for the wheel location.

b. Common Blocks Required:

INPT, DIMV, COMP, COMPN, TIRIN

c. Subroutines Required:

None

d. Arguments:

INDX - wheel number for which calculations are to be made

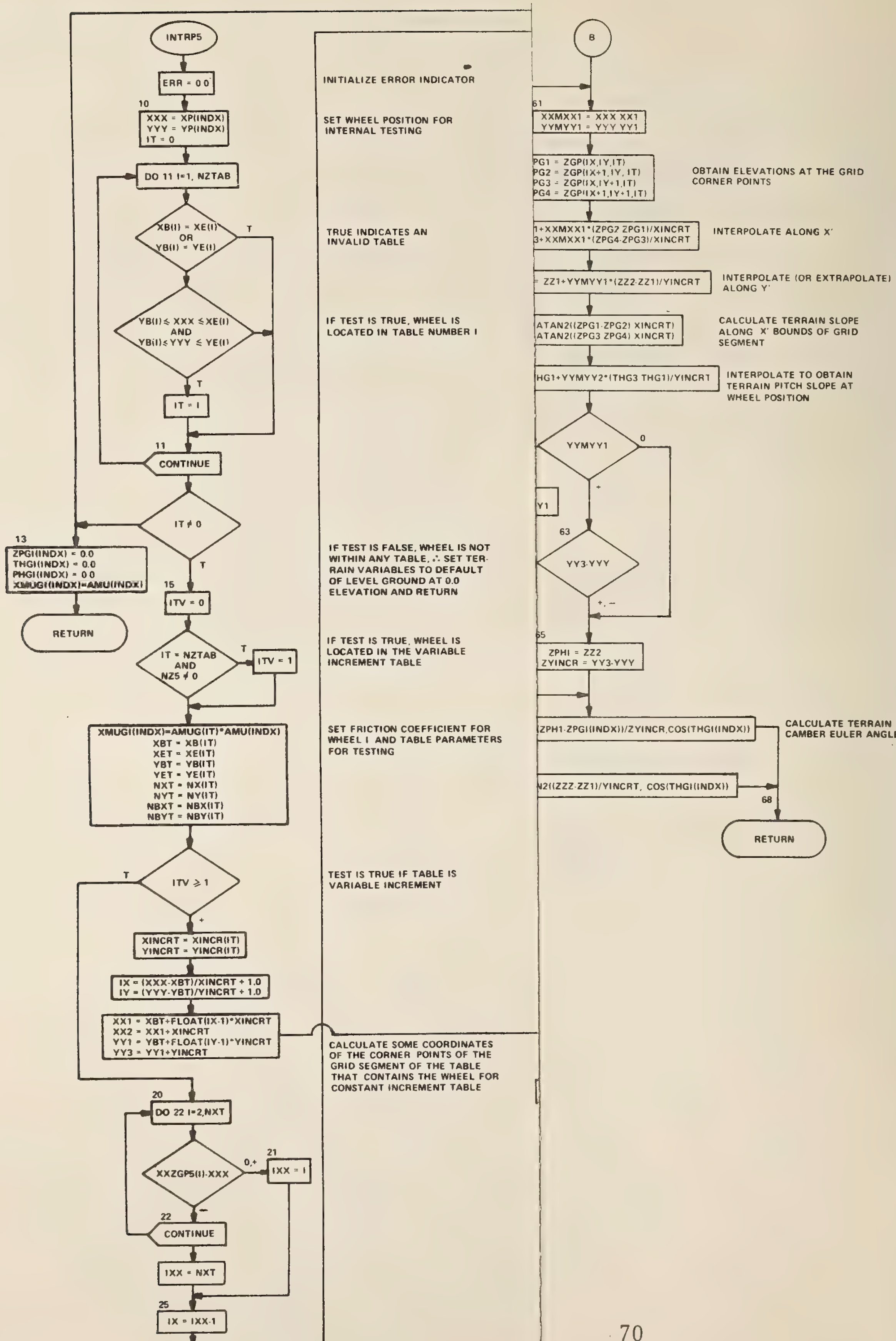
e. Common Variables Calculated:

IX, IY, XXX, XX1, XX2, YYY, YY1, YY2, ZZ1, ZZ2, PHGI, THGI, THG1, ZPGI, XMUGI

f. Size:

$129C)_{16} = 4764)_{10}$ bytes

g. Computational Procedure:


INTRP5
ERR = 0.0
INITIALIZE ERROR INDICATOR
10
XXX = XP(INDX)
YYY = YP(INDX)
IT = 0
SET WHEEL POSITION FOR INTERNAL TESTING
DO 11 I=1, NZTAB
XB(I) = XE(I) OR YB(I) = YE(I)
T
TRUE INDICATES AN INVALID TABLE
YB(I) ≤ XXX ≤ XE(I) AND YB(I) ≤ YYY ≤ YE(I)
IF TEST IS TRUE, WHEEL IS LOCATED IN TABLE NUMBER I
T
IT = I
11
CONTINUE
IT ≠ 0
13
ZPGI(INDX) = 0.0
THGI(INDX) = 0.0
PHGI(INDX) = 0.0
XMUGI(INDX)=AMU(INDX)
RETURN
T
IF TEST IS FALSE, WHEEL IS NOT WITHIN ANY TABLE, ∴ SET TERRAIN VARIABLES TO DEFAULT OF LEVEL GROUND AT 0.0 ELEVATION AND RETURN
15
ITV = 0
IT = NZTAB AND NZ5 ≠ 0
T
ITV = 1
IF TEST IS TRUE, WHEEL IS LOCATED IN THE VARIABLE INCREMENT TABLE
XMUGI(INDX)=AMUG(IT)*AMU(INDX)
XBT = XB(IT)
XET = XE(IT)
YBT = YB(IT)
YET = YE(IT)
NXT = NX(IT)
NYT = NY(IT)
NBXT = NBX(IT)
NBYT = NBY(IT)
SET FRICTION COEFFICIENT FOR WHEEL I AND TABLE PARAMETERS FOR TESTING
ITV ≥ 1
T
+
TEST IS TRUE IF TABLE IS VARIABLE INCREMENT
XINCRT = XINCR(IT)
YINCRT = YINCR(IT)
IX = (XXX-XBT)/XINCRT + 1.0
IY = (YYY-YBT)/YINCRT + 1.0
XX1 = XBT+FLOAT(IX-1)*XINCRT
XX2 = XX1+XINCRT
YY1 = YBT+FLOAT(IY-1)*YINCRT
YY3 = YY1+YINCRT
CALCULATE SOME COORDINATES OF THE CORNER POINTS OF THE GRID SEGMENT OF THE TABLE THAT CONTAINS THE WHEEL FOR CONSTANT INCREMENT TABLE
20
DO 22 I=2,NXT
XXZGP5(I)-XXX
0,+
21
IXX = I
−
22
CONTINUE
IXX = NXT
25
IX = IXX-1
B
61
XXMXX1 = XXX-XX1
YYMYY1 = YYY-YY1
PG1 = ZGP(IX,IY,IT)
PG2 = ZGP(IX+1,IY, IT)
PG3 = ZGP(IX,IY+1,IT)
PG4 = ZGP(IX+1,IY+1,IT)
OBTAIN ELEVATIONS AT THE GRID CORNER POINTS
1+XXMXX1*(ZPG2-ZPG1)/XINCRT
3+XXMXX1*(ZPG4-ZPG3)/XINCRT
INTERPOLATE ALONG X'
= ZZ1+YYMYY1*(ZZ2-ZZ1)/YINCRT
INTERPOLATE (OR EXTRAPOLATE) ALONG Y'
ATAN2((ZPG1-ZPG2) XINCRT)
ATAN2((ZPG3 ZPG4) XINCRT)
CALCULATE TERRAIN SLOPE ALONG X' BOUNDS OF GRID SEGMENT
HG1+YYMYY2*(THG3 THG1)/YINCRT
INTERPOLATE TO OBTAIN TERRAIN PITCH SLOPE AT WHEEL POSITION
YYMYY1
0
+
Y1
63
YY3-YYY
+, −
65
ZPHI = ZZ2
ZYINCR = YY3-YYY
(ZPH1-ZPGI(INDX))/ZYINCR,COS(THGI(INDX))
CALCULATE TERRAIN CAMBER EULER ANGLE
N2((ZZ2-ZZ1)/YINCRT, COS(THGI(INDX))
68
RETURN

24. SUBROUTINE MATRIX

a. Purpose:

1. Evaluate the elements of the inertial matrix for the ten coupled degrees of freedom (DMATX(I,J), I = 1,10, J = 1,10) for the independent front/solid axle rear suspension option
2. Evaluate the forcing column matrix for the ten coupled degrees of freedom (DMATX(I,11), I = 1,10) for the independent front/solid rear axle option

b. Common Blocks Required:

INPT, INTG, DIMV, COMP, ADTNL

c. Subroutines Required:

CLEAR

d. Arguments:

None

e. Common Variables Calculated:

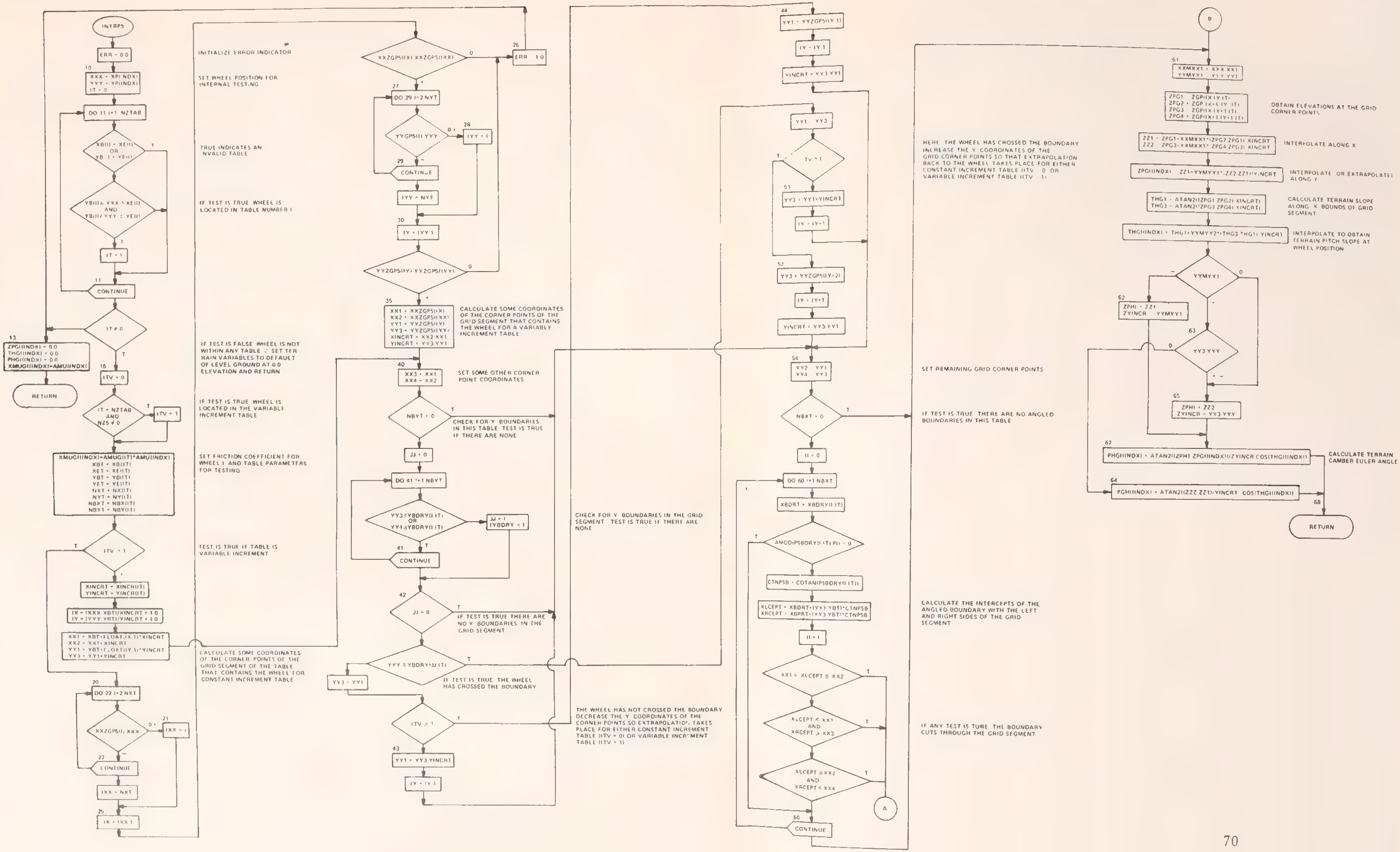
DMATX, GCTCP, GCTSP

f. Size:

$72C)_{16} = 1836)_{10}$

g. Computational Procedure:

1. Call CLEAR to zero the DMATX. This is necessary since the subroutine which decouples the equations of motion also destroys the DMATX in the process and may leave meaningless values in array elements which should be zero.
2. Calculate the elements of DMATX.



INTRPS
ERR = 0.0
INITIALIZE ERROR INDICATOR
SET WHEEL POSITION FOR INTERNAL TESTING
TRUE INDICATES AN INVALID TABLE
IF TEST IS TRUE WHEEL IS LOCATED IN TABLE NUMBER I
CONTINUE
IF TEST IS FALSE WHEEL IS NOT WITHIN ANY TABLE. SET TERRAIN VARIABLES TO DEFAULT OF LEVEL GROUND AT 0.0 ELEVATION AND RETURN
RETURN
IF TEST IS TRUE WHEEL IS LOCATED IN THE VARIABLE INCREMENT TABLE
SET FRICTION COEFFICIENT FOR WHEEL I AND TABLE PARAMETERS FOR TESTING
TEST IS TRUE IF TABLE IS VARIABLE INCREMENT
CALCULATE SOME COORDINATES OF THE CORNER POINTS OF THE GRID SEGMENT OF THE TABLE THAT CONTAINS THE WHEEL FOR CONSTANT INCREMENT TABLE
CONTINUE
CALCULATE SOME COORDINATES OF THE CORNER POINTS OF THE GRID SEGMENT THAT CONTAINS THE WHEEL FOR A VARIABLE INCREMENT TABLE
SET SOME OTHER CORNER POINT COORDINATES
CHECK FOR Y BOUNDARIES IN THIS TABLE. TEST IS TRUE IF THERE ARE NONE
IF TEST IS TRUE THERE ARE NO Y BOUNDARIES IN THE GRID SEGMENT
IF TEST IS TRUE THE WHEEL HAS CROSSED THE BOUNDARY
CHECK FOR Y BOUNDARIES IN THE GRID SEGMENT. TEST IS TRUE IF THERE ARE NONE
THE WHEEL HAS NOT CROSSED THE BOUNDARY. DECREASE THE Y COORDINATES OF THE CORNER POINTS SO EXTRAPOLATION TAKES PLACE FOR EITHER CONSTANT INCREMENT TABLE (ITV = 0) OR VARIABLE INCREMENT TABLE (ITV = 1)
HERE THE WHEEL HAS CROSSED THE BOUNDARY. INCREASE THE Y COORDINATES OF THE GRID CORNER POINTS SO THAT EXTRAPOLATION BACK TO THE WHEEL TAKES PLACE FOR EITHER CONSTANT INCREMENT TABLE (ITV = 0) OR VARIABLE INCREMENT TABLE (ITV = 1)
SET REMAINING GRID CORNER POINTS
IF TEST IS TRUE THERE ARE NO ANGLED BOUNDARIES IN THIS TABLE
CALCULATE THE INTERCEPTS OF THE ANGLED BOUNDARY WITH THE LEFT AND RIGHT SIDES OF THE GRID SEGMENT
IF ANY TEST IS TURE THE BOUNDARY CUTS THROUGH THE GRID SEGMENT
CONTINUE
OBTAIN ELEVATIONS AT THE GRID CORNER POINTS
INTERPOLATE ALONG X
INTERPOLATE (OR EXTRAPOLATE) ALONG Y
CALCULATE TERRAIN SLOPE ALONG X BOUNDS OF GRID SEGMENT
INTERPOLATE TO OBTAIN TERRAIN PITCH SLOPE AT WHEEL POSITION
CALCULATE TERRAIN CAMBER EULER ANGLE
RETURN

25. SUBROUTINE MTRXIR

a. Purpose:

1. Evaluate the elements of the inertial matrix for the ten coupled degrees of freedom (DMATX(I,J), I = 1,10, J = 1,10) for the independent rear suspension option.
2. Evaluate the forcing column matrix for the ten coupled degrees of freedom (DMATX(I,11), I = 1, 10) for the independent rear suspension option.

b. Common Blocks Required:

INPT, INTG, DIMV, COMP, ADTNL, SUSCMP

c. Subroutines Required:

CLEAR

d. Arguments:

None

e. Common Variables Calculated:

DMATX, GCTCP, GCTSP

f. Size:

$4C0)_{16} = 1216)_{10}$ bytes

g. Computational Procedure:

1. Call CLEAR to zero the DMATX. This is necessary since the subroutine which decouples the equations of motion also destroys the DMATX in the process and may leave meaningless values in array elements which should be zero
2. Calculate the elements of DMATX

26. SUBROUTINE MTRXSF

a. Purpose:

1. Evaluate the elements of the inertial matrix for the ten coupled degrees of freedom (DMATX(I,J), I = 1,10, J = 1,10) for the solid front axle option
2. Evaluate the forcing column matrix for the ten coupled degrees of freedom (DMATX(I,11), I = 1,10) for the solid front axle option

b. Common Blocks Required:

INPT, INTG, DIMV, COMP, ADTNL, SUSCMP, INSUS

c. Subroutines Required:

CLEAR

d. Arguments:

None

e. Common Variables Calculated:

DMATX, GCTCP, GCTSP

f. Size:

$962)_{16} = 2402)_{10}$ bytes

g. Computational Procedure:

1. Call CLEAR to zero the DMATX. This is necessary since the subroutine which decouples the equations of motion also destroys the DMATX in the process and may leave meaningless values in array elements which should be zero
2. Calculate the elements of DMATX

27. SUBROUTINE NLDFL

a. Purpose:

1. Calculate barrier force due to deflection and velocity of deflection
2. Calculate energy absorbed in barrier deformation

b. Common Blocks Required:

INTG, INPT2, BARIER

c. Subroutines Required:

POLY

d. Arguments:

None

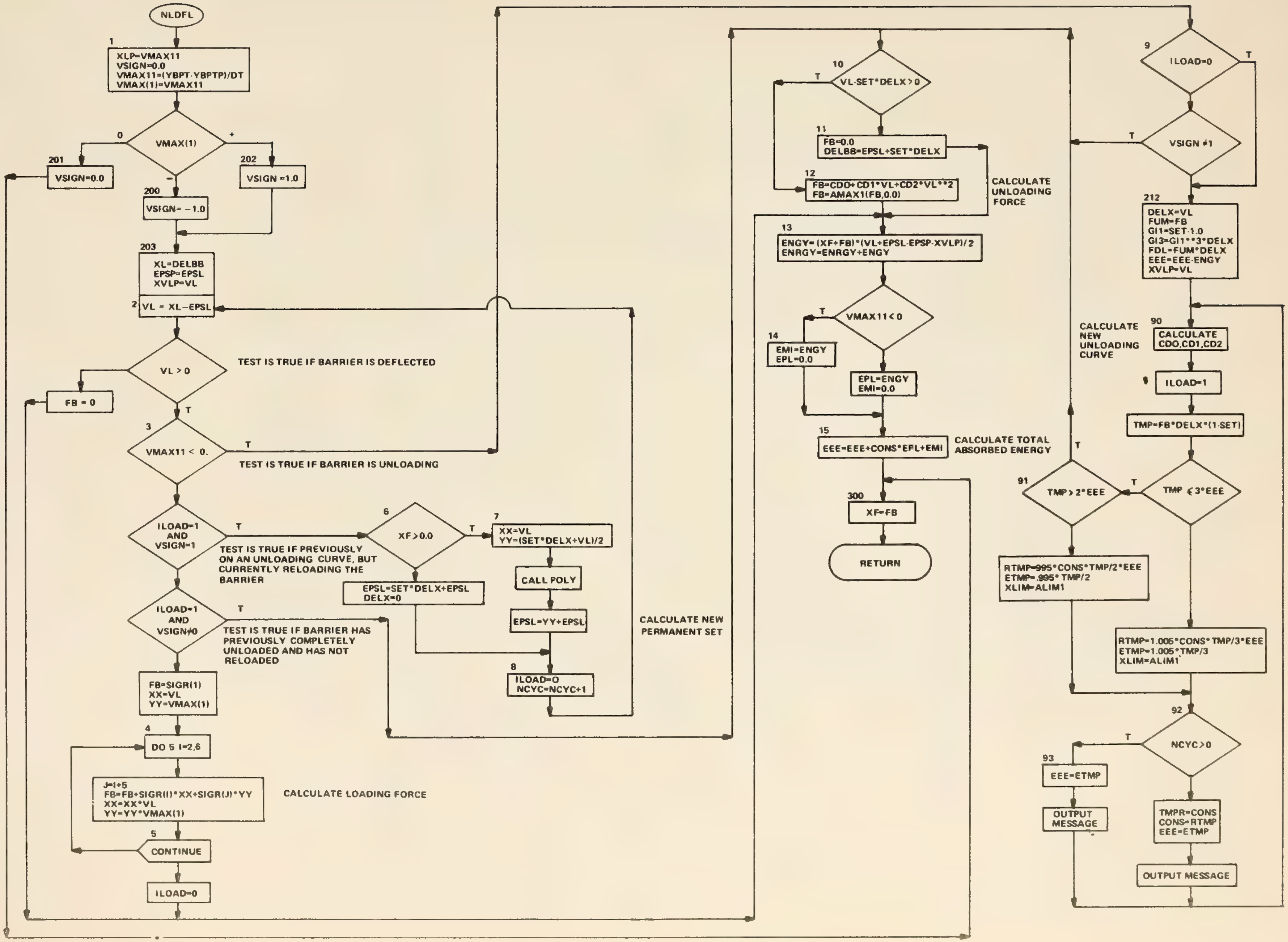
e. Common Variables Calculated:

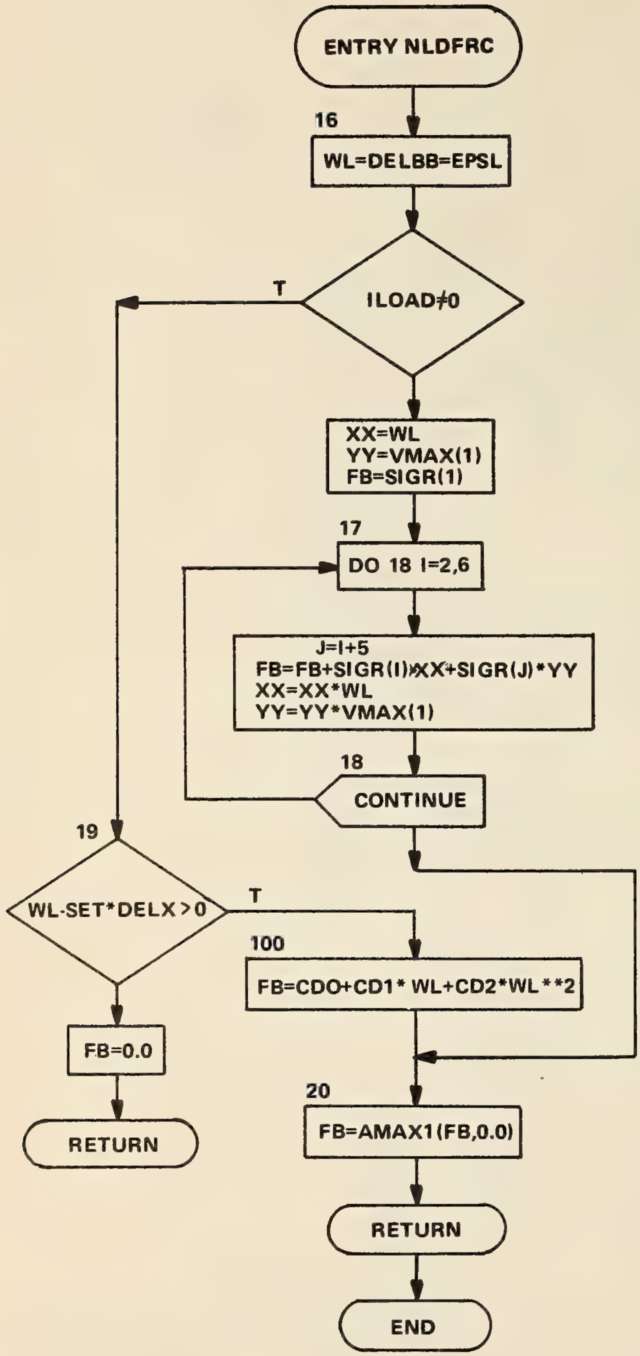
FB, VL, SF, XF, EEE, CONS, DELX, EPSL, NCYC, VMAX, DELBB, ENRGY

f. Size:

$7FC)_{16} = 2044)_{10}$ bytes

g. Computational Procedure:


NLDFL
1
XLP=VMAX11
VSIGN=0.0
VMAX11=(YBPT-YBPTP)/DT
VMAX(1)=VMAX11
VMAX(1)
0
+
−
201
VSIGN=0.0
202
VSIGN =1.0
200
VSIGN= −1.0
203
XL=DELBB
EPSP=EPSL
XVLP=VL
2
VL = XL−EPSL
VL > 0
TEST IS TRUE IF BARRIER IS DEFLECTED
FB = 0
3
VMAX11 < 0.
TEST IS TRUE IF BARRIER IS UNLOADING
ILOAD=1 AND VSIGN=1
TEST IS TRUE IF PREVIOUSLY ON AN UNLOADING CURVE, BUT CURRENTLY RELOADING THE BARRIER
6
XF > 0.0
7
XX=VL
YY=(SET*DELX+VL)/2
CALL POLY
EPSL=SET*DELX+EPSL
DELX=0
EPSL=YY+EPSL
8
ILOAD=0
NCYC=NCYC+1
CALCULATE NEW PERMANENT SET
ILOAD=1 AND VSIGN≠0
TEST IS TRUE IF BARRIER HAS PREVIOUSLY COMPLETELY UNLOADED AND HAS NOT RELOADED
FB=SIGR(1)
XX=VL
YY=VMAX(1)
4
DO 5 I=2,6
J=I+5
FB=FB+SIGR(I)*XX+SIGR(J)*YY
XX=XX*VL
YY=YY*VMAX(1)
CALCULATE LOADING FORCE
5
CONTINUE
ILOAD=0
10
VL-SET*DELX > 0
11
FB=0.0
DELBB=EPSL+SET*DELX
12
FB=CDO+CD1*VL+CD2*VL**2
FB=AMAX1(FB,0.0)
CALCULATE UNLOADING FORCE
13
ENGY=(XF+FB)*(VL+EPSL-EPSP-XVLP)/2
ENRGY=ENRGY+ENGY
VMAX11 < 0
14
EMI=ENGY
EPL=0.0
EPL=ENGY
EMI=0.0
15
EEE=EEE+CONS*EPL+EMI
CALCULATE TOTAL ABSORBED ENERGY
300
XF=FB
RETURN
9
ILOAD=0
VSIGN ≠1
212
DELX=VL
FUM=FB
GI1=SET-1.0
GI3=GI1**3*DELX
FDL=FUM*DELX
EEE=EEE-ENGY
XVLP=VL
CALCULATE NEW UNLOADING CURVE
90
CALCULATE CDO,CD1,CD2
ILOAD=1
TMP=FB*DELX*(1-SET)
TMP ≤ 3*EEE
91
TMP > 2*EEE
RTMP=.995*CONS*TMP/2*EEE
ETMP=.995*TMP/2
XLIM=ALIM1
RTMP=1.005*CONS*TMP/3*EEE
ETMP=1.005*TMP/3
XLIM=ALIM1
92
NCYC > 0
93
EEE=ETMP
OUTPUT MESSAGE
TMPR=CONS
CONS=RTMP
EEE=ETMP
OUTPUT MESSAGE



CALCULATE LOADING FORCE

CALCULATE UNLOADING FORCE

28. SUBROUTINE OUTPUT(IND)

a. Purpose:

1. Print output page titles and output data

b. Common Blocks Required:

HEAD, INPT, INTG, DIMV, COMP, COMPN, ADTNL, INSUS, SUSCMP, BARSTR

c. Subroutines Required:

None

d. Arguments:

If IND = 0, an output line counter is initialized to zero.

e. Common Variables Calculated:

None

f. Size:

$3EBC)_{16} = 16060)_{10}$ bytes

g. Computational Procedure:

Each time a call to this subroutine is executed, an output line of data is written to FORTRAN devices 11 through, at most, 29. The number of devices actually written to is dependent on the indicators contained in the NPAGE array. These indicators are set either by the user on input card 104 or by the program depending on the options in use.

On either the first call to the subroutine with IND $\neq$ 0 or after 50 lines of data have been written, page headings are written for each page of data.

An entry point, THPLOT, is provided to write static and dynamic data to FORTRAN device 3 for the purpose of subsequent plotting of time history data.

29. SUBROUTINE PINT1(IN, MODE, N, X, H, Y, YP, A)

a. Purpose:

1. To integrate a system of N ordinary differential equations of the first order

b. Common Blocks Required:

None

c. Subroutines Required:

DAUX

d. Arguments:

IN is the control word (= 1 or 2) for initialization or to integrate one step-size;

IN = 1 - to set up the routine for integration;
IN = 2 - to integrate one step-size;

MODE is the option word (= 0, 1 or 2) for using one of the three modes of integration. When MODE equals

0 - the Adams-Moulton variable step-size is used;
1 - the Runge-Kutta fixed step-size is used;
2 - the Adams-Moulton fixed step-size is used;

N is the number of first order differential equations;
X is the independent or source variable;
H is the step-size or increment in the source variable;
Y is the array of dependent or target variables updated by PINT1;
YP is the array of first derivatives of the target variables Y(N) computed in the subroutine DAUX;
A is an array of 6 cells containing the parameters $(\bar{E}, \bar{M}, \alpha, h_{max}, h_{min}, \beta)$ needed for the variable mode only;
A(1) ($\equiv \bar{E}$) is an upper bound on the truncation error (the number of significant digits which the user desired to preserve locally) for the variable Adams-Moulton method, normally $10^{-8} \leq A(1) \leq 10^{-3}$;
A(2) ($\equiv \bar{M}$) is a positive number from which the lower bound on the truncation error is computed. In particular, when A(2) is zero the routine used the normal value of 100 and in all other cases the lower bound is computed as the quotient of A(1) by A(2);
A(3) ($\equiv \alpha$) is a positive number used to prevent unnecessary reduction in the variable step-size when the dependent variables are sufficiently small. When A(3) is zero the routine uses the normal value of one;
A(4) ($\equiv h_{max}$) is a positive upper bound for the magnitude of the variable step-size. If A(4) is zero the routine assumes there is no upper bound;

A(5) ($\equiv h_{min}$) is positive lower bound for the magnitude of the variable step-size. The routine assumes there is no lower bound when A(5) is zero;

A(6) ($\equiv \beta$) is a positive number between zero and one used to increase or decrease the variable step-size. When A(6) is zero the routine assumes the value of one-half.

IN, N and MODE are integers while X, H, Y, YP and A are all single precision floating point numbers.

The arguments X, H, Y, YP, of the PINT1 calling sequence must be in a COMMON type statement.

Before executing the first PINT1 call, the user must initialize X, H and each of the Y(N) variables. The first call must use control word (IN = 1) to set up the routine for integration. The control word (IN = 2) may be used any number of times after the first to integrated one step-size, provided X, H and Y have not been redefined between integration steps.

e. Common Variables Calculated:

None

f. Size:

$1B2C)_{16} = 6956)_{10}$ bytes

g. Computational Procedure:

In this routine the user is allowed an option of using either the Runge-Kutta classical fourth-order method as modified by E. K. Blum or the Adams-Moulton predictor-corrector method using the Runge-Kutta method for starting the process.

Let the system of equations to be solved be given in the form

$$y_i = f_i(x, y_1, y_2, \cdots, y_N) \qquad (1.1)$$

$$y_i(x_0) = y_{i0} \qquad i = 1, 2, \ldots, N$$

Let y_{in} be the value of y_i at $x = x_n$ and f_{in} the derivative of y_{in} at $x = x_n$. If h is the increment (step-size) of the independent variable x, the classical Runge-Kutta fourth-order method uses the formulas

$$K_{i1} = hf_i(x_n, y_{in})$$
$$K_{i2} = hf_i(x_n + 1/2\, h,\ y_{in} + 1/2\, K_{i1})$$
$$K_{i3} = hf_i(x_n + 1/2\, h,\ y_{in} + 1/2\, K_{i2}) \tag{1.2}$$
$$K_{i4} = hf_i(x_n + h,\ y_{in} + K_{i3})$$
$$y_{i,n+1} = y_{in} + 1/6(K_{i1} + 2K_{i2} + 2K_{i3} + K_{i4})$$

where $i = 1, 2, \ldots N$

The E. K. Blum Modification:

The following recursive form of the E. K. Blum's exact modification of the Runge-Kutta is used in this routine:

$$\begin{cases} z_0 = y_n \\ q_0 = y_n \\ P_0 = hf(z_0) \end{cases} \qquad at\ x = x_0 \tag{2.1}$$

$$\begin{cases} z_1 = z_0 + P_0/2 \\ q_1 = P_0 \\ P_1 = hf(z_1) \end{cases} \qquad at\ x = x_0 + h/2 \tag{2.2}$$

$$\begin{cases} z_2 = z_1 + P_1/2 - q_1/2 \\ q_2 = q_1/6 \\ P_2 = hf(z_2) - P_1/2 \end{cases} \qquad at\ x = x_0 + h/2 \tag{2.3}$$

$$\begin{cases} z_3 = z_2 + P_2 \\ q_3 = q_2 + P_2 \\ P_3 = hf(z_3) + 2P_2 \end{cases} \qquad at\ x = x_0 + h \tag{2.4}$$

$$y_{i,n+1} \equiv z_4 = z_3 + q_3 + P_3/6 \tag{2.5}$$

(we omit the subscript from each of the vectors z_j, q_j and P_j for reasons of economy)

The main advantage of the modified Runge-Kutta formulas is that they reduce considerably the rounding error arising from the unavoidable use of digital numbers and pseudo-operations.

Adams-Moulton Predictor-Corrector Method:

The routine uses the following formulas for the system (1.1):

$$y_{i,n+1}^{[P]} = y_{i n} + h/24(55 f_{i n} - 59 f_{i,n-1} + 37 f_{i,n-2} - 9 f_{i,n-3}) \tag{3.1}$$

$$y_{i,n+1} = y_{i,n+1}^{[c]} = y_{i,n} + h/24(9 f_{i,n+1}^{[P]} + 19 f_{i n} - 5 f_{i,n-1} + f_{i,n-2}) \tag{3.2}$$

The starting values needed in the predictor formula (3.1) are obtained using the Runge-Kutta-Blum (RKB) method. In the evaluation of y_i at $x = x_{n+1}$ the predictor and corrector formulas are applied only once so that only two derivative evaluations ($f_{i,n+1}^{[P]}$ and $f_{i n}$) are needed for each Adams-Moulton (variable or fixed step-size) integration step.

The Variable Adams-Moulton:

The step-size h to be used in the variable mode is determined mainly by:

$$E_{n+1} = \max_i \frac{\left| y_{i,n+1}^{[P]} - y_{i,n+1}^{[c]} \right|}{14 D_i} \tag{3.3}$$

$$D_i = \max_i \left\{ \left| y_{i,n+1}^{[c]} \right|, \alpha \right\} \quad , \quad i = 1, 2, \ldots N$$

where

E_{n+1} is the local truncation error estimate in the actual evaluation of y_{n+1} ; α (> 0) is a constant used to prevent unnecessary reductions in $|h|$ whenever $|y_{i,n+1}|$ is small (normally the routine will set α = 1, unless otherwise specified by the user).

Let

$\bar{E}$ be the upper bound on the truncation error estimate, specified by the user, that is the number of significant digits which the user desires to preserve locally throughout the integration. Normally $\bar{E}$ should be in the range $10^{-8} \leq \bar{E} \leq 10^{-3}$ and in double precision $\bar{E}$ should be in the range $10^{-16} \leq \bar{E} \leq 15^{12}$;

M (> 0) be a constant, specified by the user, from which a lower bound $\underline{E} = \bar{M}^{-1}\bar{E}$ is obtained (normally M ranges from 50 to 150 and in double precision from 1000 to 1500);

β be a constant between 0 to 1 used to increase or decrease the step-size. The routine will take $\beta = 1/2$ unless β is otherwise specified by the user.

The step-size h will be then increased or decreased according to the following inequalities:

If

(4.1)	$E_{n+1} > \bar{E}$	the step-size is reduced to βh, where $0 < \beta < 1$;
(4.2)	$M^{-1}\bar{E} < E_{n+1} < \bar{E}$	the step-size remains unchanged;
(4.3)	$E_{n+1} < M^{-1}\bar{E}$	for 3 successive integration steps the step-size is increased to h/β.

Increasing and Decreasing the Step-Size:

The starting values, the first three successive points after the initial point p_0, for the Adams-Moulton formulas are always obtained using the RKB method whenever the interval size is changed, just as at the beginning of an integration.

In the variable mode if the starting values, the first three successive points, have been obtained using the RKB method then the next point is computed using the Adams-Moulton predictor-corrector formulas (3.1) and (3.2). Whenever the truncation error at this point calls for a decrease in h the routine returns to the initial point p_0 and computes new starting values with the decreased value of h. However, if the step-size is to be decreased at a point p_i, where the preceeding point p_{i-1} was computed in the variable mode and the inequality (4.2) held at p_{i-1}, then a new start is initiated at p_{i-1} with decreased value of $|h|$.

If for three successive variable integration steps p_{i-1}, p_i and p_{i+1} inequality (4.3) holds, then a new start is initiated at p_{i+1} with the increased value of $|h|$. After an interval is increased, the routine prevents increasing again until 6 more points have been complete. However, the routine may decrease the interval as often as necessary. The truncation error test based on (3.3) will guarantee that the local error does not exceed $\bar{E}$, however the cumulative error will usually exceed $\bar{E}$. Hence $\bar{E}$ should be chosen sufficiently small to allow for an accumulation of truncation error.

The user must always provide a starting value for h and he may, if desired, specify a maximum value of $|h|$, h_{max} beyond which the routine will not increase h and a minimum value of $|h|$, h_{min}, below which it will not decrease h. If no value is specified for h_{max} and h_{min} the routine will set the values at 10^3 and 10^{-17}, respectively.

Negative values of h may be used for backward integration.

Control and DAUX:

There are two entries to this routine. The first (control word = 1) must be used once at the beginning to set up the routine for integration of a given set of N differential equations. The second entry (control word = 2) may be used any number of times after the first to integrate all y_i from x to $x+h$.

Whenever the control word is 1 the routine uses the auxiliary subroutine DAUX to evaluate the derivatives at the initial point $x = x_0$ and returns with all y_i unchanged. The routine also checks and sets up the six parameter words $\bar{E}$, M, α, h_{max}, h_{min} and β needed in the variable mode of operation. Before executing the initialization entry, the user must have already set up the appropriate values for x, h and y_i, $i = 1, 2, \ldots N$. Ordinarily, after an execution of the second entry all y_i assume new values, x will have been advanced to the value $x+h$ and h will be unchanged, unless in the variable mode. On exit the values y_i are always these which correspond to the point $x+h$ and y_i.

Whenever an integration step involves RKB integration, four derivative evaluations are needed, mainly

$$
\begin{aligned}
&f_i(x_n + 1/2h,\ y_{in} + 1/2\, K_{1i}) \\
&f_i(x_n + 1/2h,\ y_{in} + 1/2\, K_{i2}) \\
&f_i(x_n + h,\ y_{in} + K_{i3}) \\
&y_{i,n+1} = f_i(x_n + h,\ y_{n+1})
\end{aligned}
\qquad (5.1)
$$

where the K_{ij} are given by (1.2) and modified by (2.1) - (2.5). In the fixed h predictor-corrector mode, the first three integration entries involve RKB integration and subsequent ones involve AM integration. Each AM integration step requires two derivative evaluations.

$$
\begin{aligned}
f^{[p]}_{i,n+1} &= f_i(x_n + h,\ y^{[p]}_{i,n+1}) \\
y'_{i,n+1} &= f_i(x_n + h,\ y_{i,n+1})
\end{aligned}
\qquad (5.2)
$$

A particular integration set up, in the variable mode, may involve either AM or RKB or both.

References:

(1) SHARE Write-Up No. 0602 (D2RWINT)
(2) SHARE Write-Up No. 0450 (D2RDE2F)
(3) Blum, K. E., A Modification of the Runge-Kutta Fourth Order Method, Mathematics of Computation, April 1962, pp. 176-187

30. SUBROUTINE PLOTTP(IPLT)

a. Purpose:

1. Write output to FORTRAN device 1 for post-processing graphic displays

b. Common Blocks Required:

INPT, INTG, DIMV, COMP, COMPN, TIRIN

c. Subroutines Required:

None

d. Arguments:

IPLT controls the type of record written; static, dynamic or end of data, for values of IPLT of 1, 2 and 3, respectively

e. Common Variables Calculated:

None

f. Size:

$324)_{16} = 804)_{10}$ bytes

g. Computational Procedure:

1. If IPLT = 1 a static header record is written to device 1 consisting of the following variables: HED, DADE, A, B, TS, ZR, RHO, ZF, RW, TF, TR
2. If IPLT = 2 a dynamic record is written consisting of: T, XCP, YCP, ZCP, PHIT, THETT, PSIT, DEL1, DEL2, DEL3, PHIR, PSI1, PHI1, PHI2, (XGPP(I), YGPP(I), ZGPP(I), I = 1,4), (ICONTW(I), I = 1,4). Note: ICONTW is an indicator. If 1, wheel I is rolling; if -1, wheel I is skidding; if 0, wheel I is off the ground.
3. If IPLT = 3, an end of data record consisting of 30 works of -9999.0 is written.

31. SUBROUTINE POLY

a. Purpose:

1. To find root of a fifth degree polynomial

b. Common Blocks Required:

None

c. Subroutines Required:

None

d. Arguments:

C0 - zeroth order polynomial coefficient
C - array containing polynomial coefficients
X - initial approximation
Y - polynomial root
C1 - polynomial value

e. Common Variables Calculated:

None

f. Size:

$234)_{16} = 564)_{10}$ bytes

g. Computational Procedure:

The root of the polynomial is found by the Newton-Raphson Method

32. SUBROUTINE RESFRC

a. Purpose:

1. Calculate frictional force between the vehicle and barrier
2. Calculate the force and moment components acting on the vehicle

b. Common Blocks Required:

INTG, DIMV, COMP, INPT2, BARIER, BARSTR, HARDPT

c. Subroutines Required:

None

d. Arguments:

None

e. Common Variables Calculated:

SXR, SYR, SZR, UPT, URP, VPT, VRP, WPT, WRP, SFXS, SFYS, SFZS, SNPS, SNTS, VTAN, FRICF, FRICT, SNPSS

f. Size:

$4F4)_{16} = 1268)_{10}$ bytes

g. Computational Procedure:

1. Compute the location of the point of application of the vehicle crush force (SXR, SYR, SZR) and store in the first element of the X, Y and Z arrays
2. Store the locations of the point of application of the vehicle hard point forces in the second, third and fourth elements of those arrays
3. Compute the velocity components of those four points in the space axes (UPT(I), VPT(I), WPT(I), I = 1,4)
4. Compute the friction force components for each point, the total force vector components in the vehicle axis system (SFXS, SFYS, SFZS) and the moments acting on the vehicle sprung mass (SNPS, SNTS, SNPSS)

SUBROUTINE RUFFRC(I,ZGM)

a. Purpose:

1. To determine an equivalent radial tire force and ground contact point from the distributed tire spring model when the road roughness option is being used

b. Common Blocks Required:

INPT1, DIMV, COMP, COMPN, TIRIN, RUFNES

c. Subroutines Required:

INTRPL

d. Arguments:

I = wheel number for which calculations are made
ZGM = single dimensional array containing the road roughness data

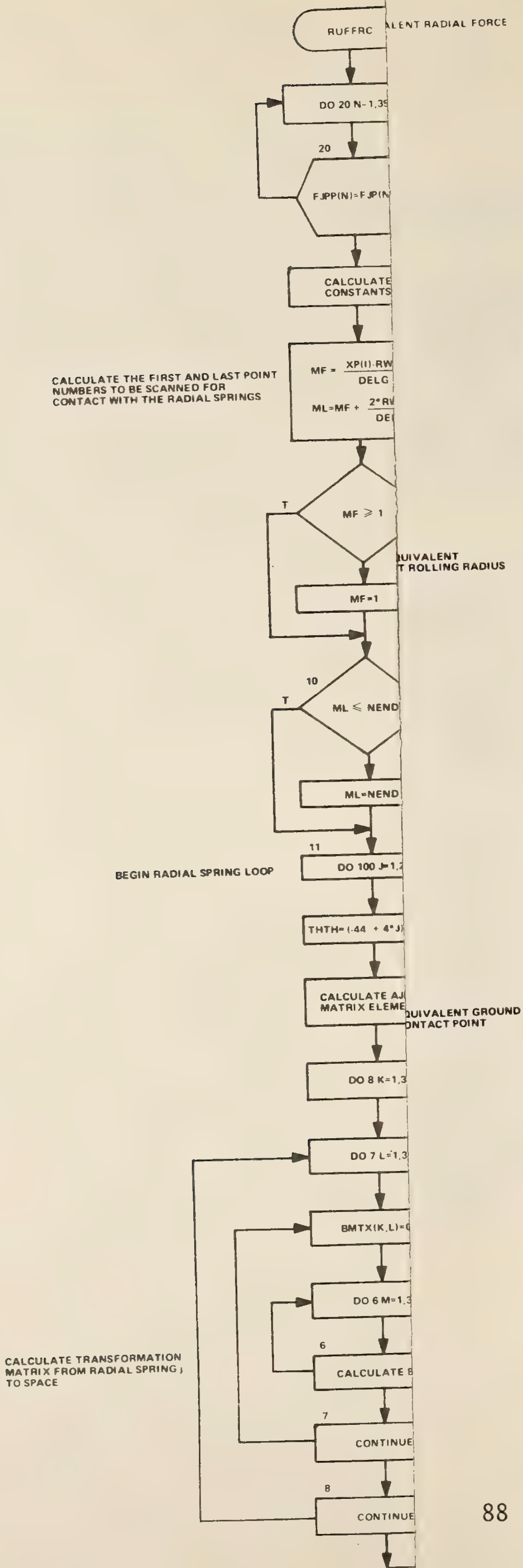
e. Common Variables Calculated:

FR, HI, CAR, CBR, CGR, CPG, CTG, SPG, STG, BMTX, PHGI, SFRX, SFRY, SFRZ, XGPP, YGPP, ZGPP, AJMTX

f. Size:

$DC4)_{16} = 3524)_{10}$ bytes

g. Computational Procedure:



RUFFRC
LENT RADIAL FORCE
DO 20 N-1,39
20
FJPP(N)=FJP(N
CALCULATE
CONSTANTS
CALCULATE THE FIRST AND LAST POINT NUMBERS TO BE SCANNED FOR CONTACT WITH THE RADIAL SPRINGS
MF = XP(I)-RW / DELG
ML=MF + 2*RW / DEL
T
MF ≥ 1
UIVALENT
T ROLLING RADIUS
MF=1
10
T
ML ≤ NEND
ML=NEND
11
BEGIN RADIAL SPRING LOOP
DO 100 J=1,2
THTH=(-44 + 4*J)
CALCULATE AJ
MATRIX ELEME
UIVALENT GROUND
ONTACT POINT
DO 8 K=1,3
DO 7 L=1,3
BMTX(K,L)=0
DO 6 M=1,3
6
CALCULATE TRANSFORMATION MATRIX FROM RADIAL SPRING J TO SPACE
CALCULATE B
7
CONTINUE
8
CONTINUE

34. SUBROUTINE RUFRED(NEND,DELG,DGMAX,ZRTAB)

a. Purpose:

1. Read road roughness data from FORTRAN device 4

b. Common Blocks Required:

None

c. Subroutine Required:

None

d. Arguments:

NEND = the number of road roughness points to be read from FORTRAN unit 4
DELG = the distance increment between points
DGMAX = (NEND-1) * DELG
ZRTAB = a single dimension array into which the road roughness data is read

e. Common Variables Calculated:

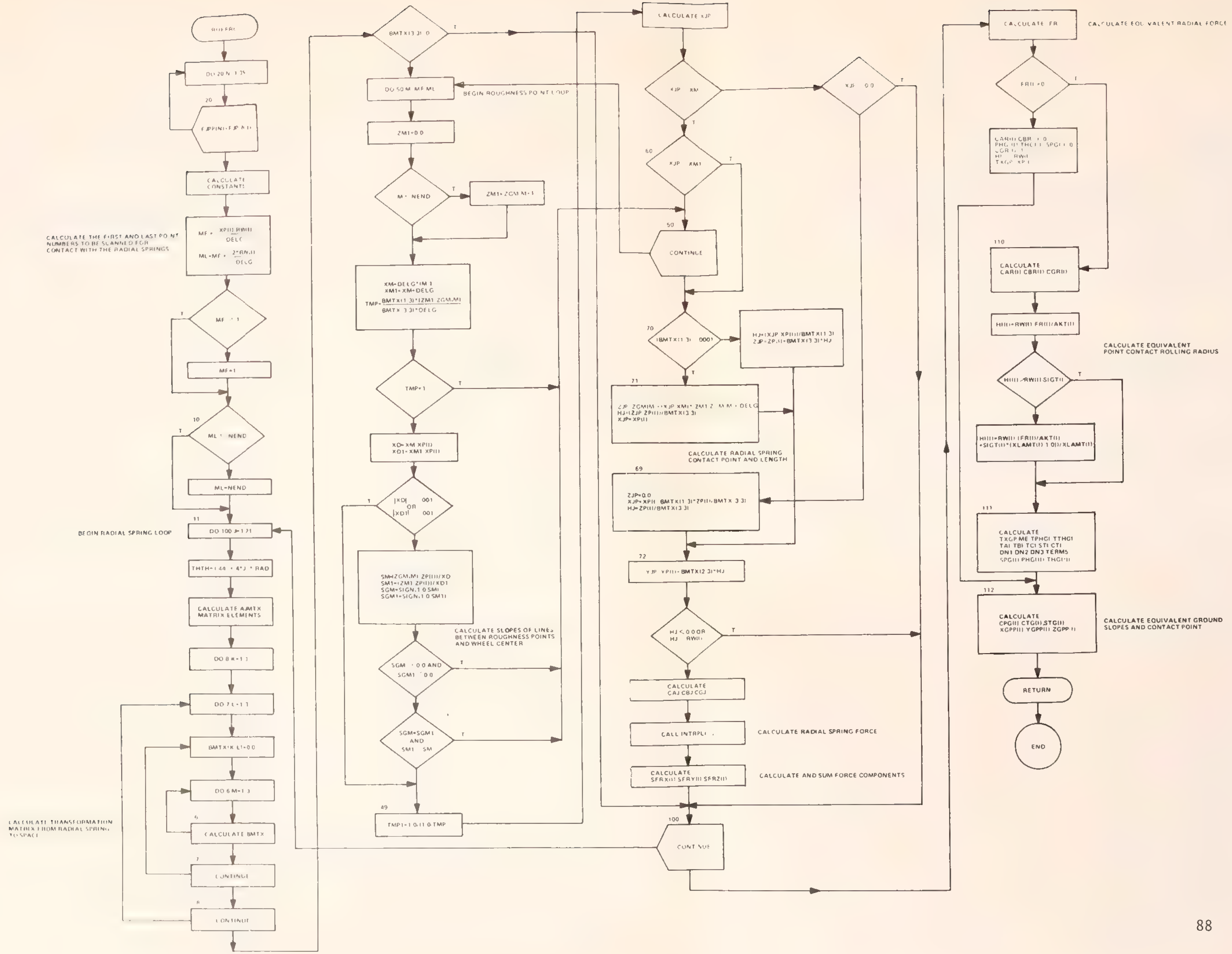
None

f. Size:

$2B8)_{16} = 696)_{10}$ bytes

g. Computational Procedure:

The road roughness data is read via an unformatted READ statement into the ZRTAB array. The maximum number of points allowed is 2200.



CALCULATE CONSTANTS
CALCULATE THE FIRST AND LAST POINT NUMBERS TO BE SCANNED FOR CONTACT WITH THE RADIAL SPRINGS
MF=1
ML=NEND
BEGIN RADIAL SPRING LOOP
CALCULATE AJMTX MATRIX ELEMENTS
CALCULATE TRANSFORMATION MATRIX FROM RADIAL SPRING TO SPACE
CALCULATE BMTX
CONTINUE
BEGIN ROUGHNESS POINT LOOP
ZM1=0.0
CALCULATE SLOPES OF LINES BETWEEN ROUGHNESS POINTS AND WHEEL CENTER
CALCULATE XJP
CONTINUE
CALCULATE RADIAL SPRING CONTACT POINT AND LENGTH
CALCULATE CAJ CBJ CGJ
CALCULATE RADIAL SPRING FORCE
CALCULATE SFRX(I) SFRY(I) SFRZ(I)
CALCULATE AND SUM FORCE COMPONENTS
CALCULATE FR
CALCULATE EQUIVALENT RADIAL FORCE
CALCULATE CAR(I) CBR(I) CGR(I)
CALCULATE EQUIVALENT POINT CONTACT ROLLING RADIUS
CALCULATE EQUIVALENT GROUND SLOPES AND CONTACT POINT
RETURN
END

35. SUBROUTINE SIMSOL

a. Purpose:

1. This subroutine solves a set of real simultaneous linear algebraic equations AX = B, with input, output and internal computation all in single precision.

b. Common Blocks Required:

None

c. Subroutines Required:

None

d. Arguments:

A - is a 2-dimensional (ND1 x ND2) matrix of coefficients
N - is the number of equations and unknowns
ND1 - is the first dimension of A in the calling program (ND1. GE. N and ND2. GE. N+1)

e. Common Variables Calculated:

None

f. Size:

$5E8)_{16} = 1512)_{10}$ bytes

g. Computational Procedure:

The routine will find the solution X of AX = B where A is a N by N matrix and B(I) is stored in A(I, N+1).
The solution X(I) is returned in A(I, N+1).

Note: The Matrix A is destroyed by the subroutine.

```
Example:  REAL A(20,25)
          CALL SIMSOL (A, 10, 20)
```

The solution is obtained by elimination using the largest pivotal divisor of each column. Each stage of elimination consists of interchanging rows when necessary to avoid division by zero or small numbers.

The forward solution to obtain variable N is done in N stages. The back solution for the other variables is calculated by successive substitutions. The final solution values are developed in column N+1 of matrix A, with variable 1 and A (1, N+1), variable 2 in A(2, N+1), ..., and variable N in A (N, N+1).

36. SUBROUTINE SFORCE

a. Purpose:

1. Calculate sprung mass impact force due to vehicle interference with barrier

b. Common Blocks Required:

INTG, DIMV, COMP, COMPN, INPT2, BARIER, BARSTR, HARDPT

c. Subroutines Required:

SIMSOL, AREA, NLDFL, RESFRC

d. Arguments:

None

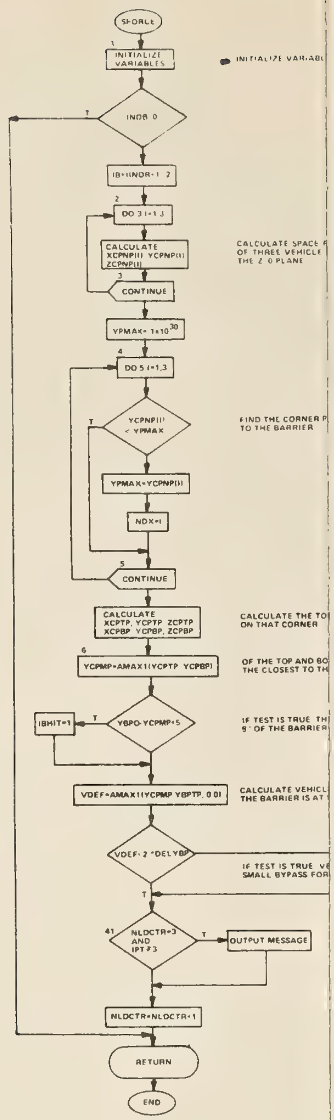
e. Common Variables Calculated:

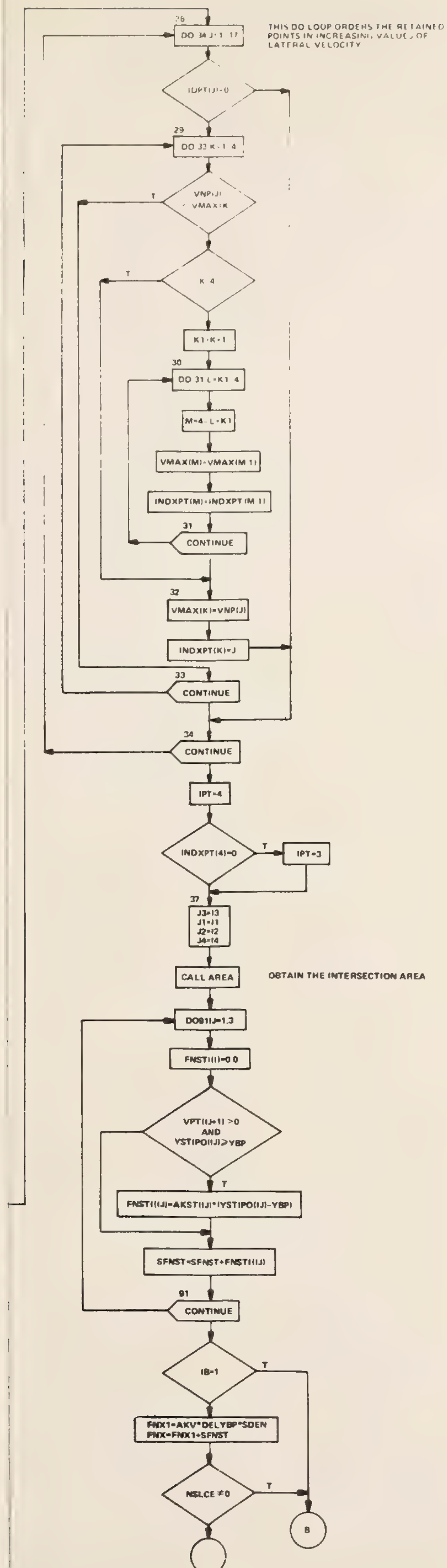
FB, FN, RB, AA2, BB2, CAB, CBB, CC2, CGB, IPT, RB1, RR2, SXR, SYR, SZR, UNP, VNP, WNP, XBB, XBT, XNN, XRI, YBT, YNN, YRI, ZBB, ZBT, ZNN, ZRI, CABT, CAB1, CBBT, CBB1, CGBT, CGB1, IPLN, IDPT, NSEG, RR2P, SDEN, SFXS, SFYS, SFZS, SNPS, SNTS, VDEF, VMAX, VTAN, XMTX, XSTI, YBPT, YSTI, ZSTI, AINTI, DELBB, FNSTI, FRICT, ININD, IBHIT, NUNLD, SNPSS, XCPBP, XCPNP, XCPTP, XSTIP, YCPBP, YCPMP, YCPNP, YCPTP, YSTIP, ZCPBP, ZCPNP, ZCPTP, ZSTIP, INDXPT, NLDCTR

f. Size:

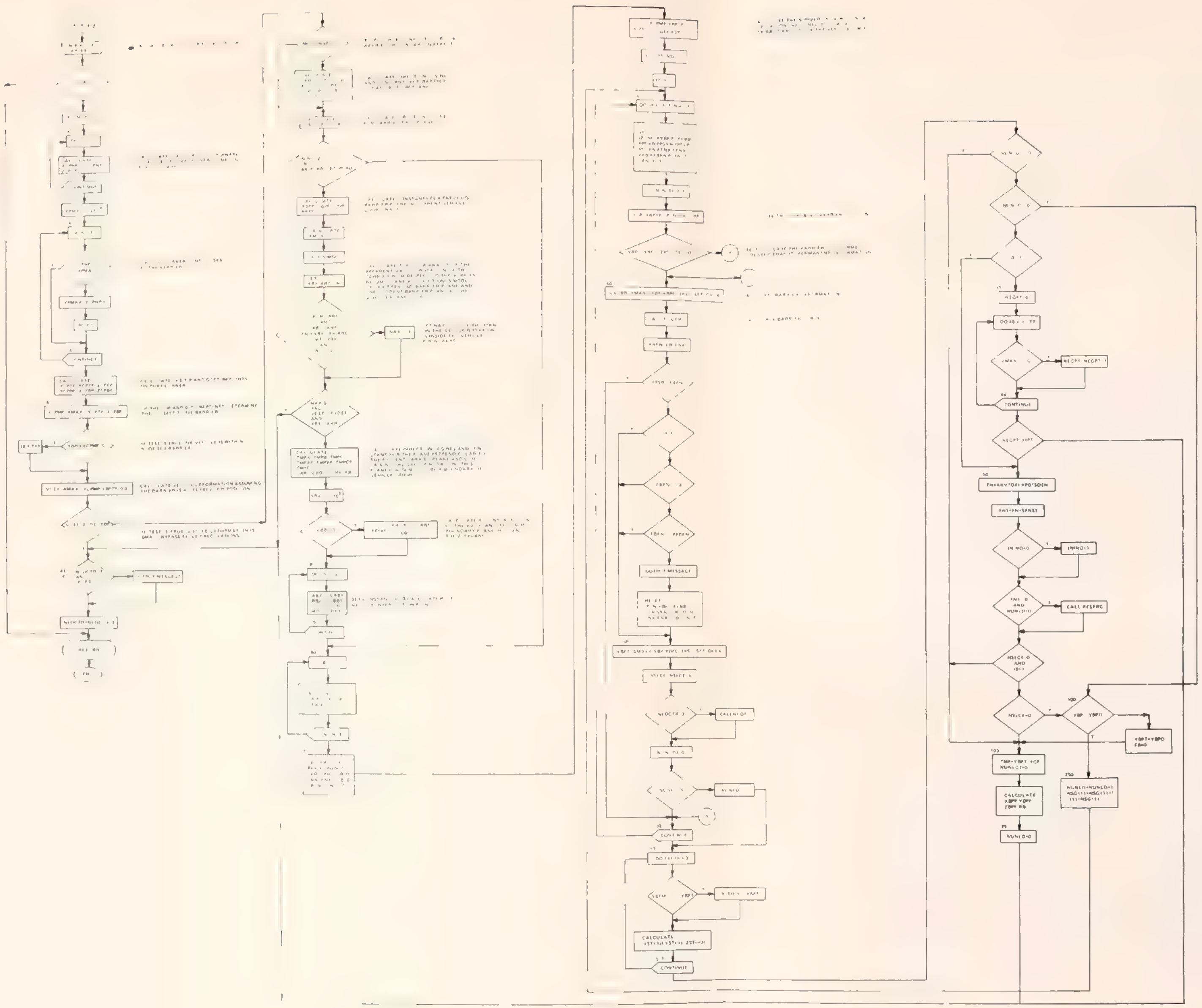
$1E90)_{16} = 7824)_{10}$ bytes

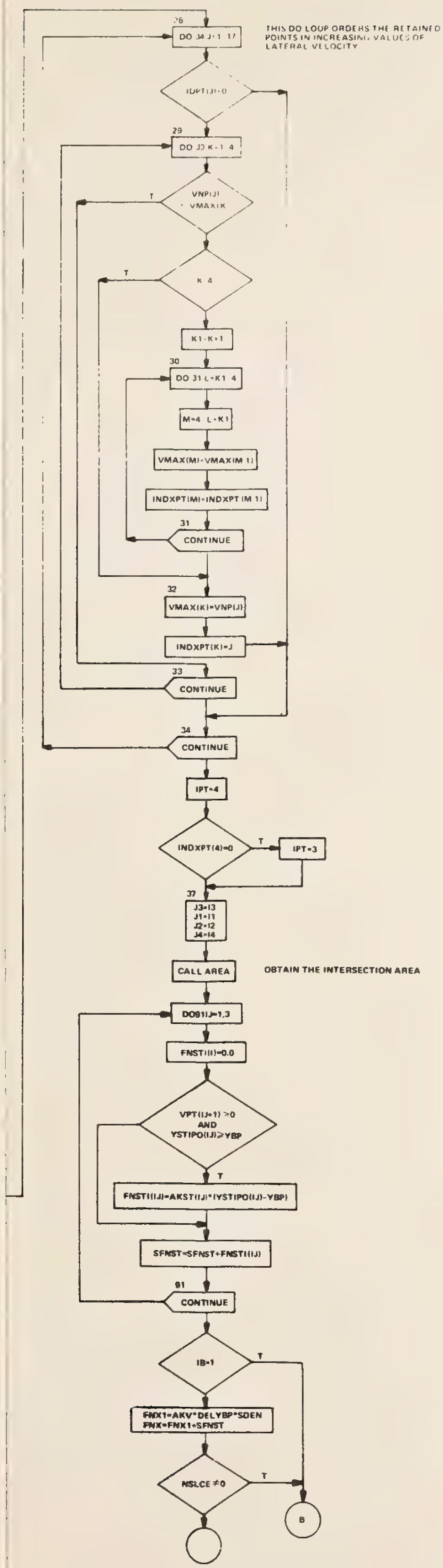
g. Computational Procedure:

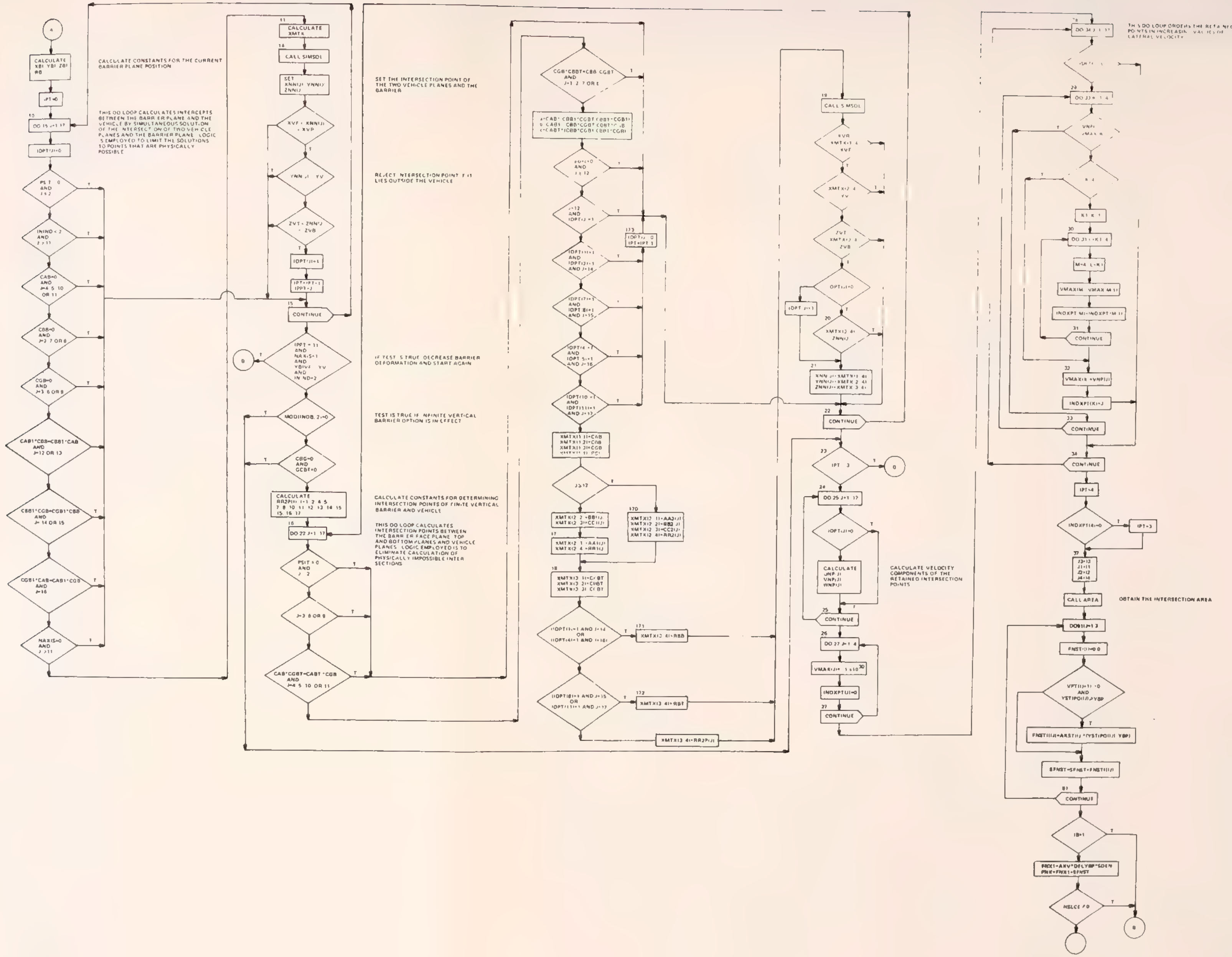

SFORCE
1
INITIALIZE VARIABLES
INITIALIZE VARIABL
INDB 0
T
IB=(INDB+1) 2
2
DO 3 I=1,3
CALCULATE XCPNP(I) YCPNP(I) ZCPNP(I)
CALCULATE SPACE
OF THREE VEHICLE
THE Z 0 PLANE
3
CONTINUE
YPMAX= 1x10^30
4
DO 5 I=1,3
YCPNP(I) < YPMAX
T
FIND THE CORNER
TO THE BARRIER
YPMAX=YCPNP(I)
NDX=I
5
CONTINUE
CALCULATE XCPTP, YCPTP ZCPTP XCPBP YCPBP, ZCPBP
CALCULATE THE TO
ON THAT CORNER
6
YCPMP=AMAX1(YCPTP YCPBP)
OF THE TOP AND BO
THE CLOSEST TO TH
IBHIT=1
T
YBPO-YCPMP<5
IF TEST IS TRUE TH
5' OF THE BARRIER
VDEF=AMAX1(YCPMP YBPTP, 0.0)
CALCULATE VEHICL
THE BARRIER IS AT
VDEF<2 *DELYBP
IF TEST IS TRUE VE
SMALL BYPASS FOR
T
41
NLDCTR=3 AND IPT≠3
T
OUTPUT MESSAGE
NLDCTR=NLDCTR+1
RETURN
END



THIS DO LOOP ORDERS THE RETAINED POINTS IN INCREASING VALUES OF LATERAL VELOCITY
29
T
K1·K+1
30
M=4-L-K1
VMAX(M)=VMAX(M 1)
INDXPT(M)=INDXPT(M 1)
31
CONTINUE
32
VMAX(K)=VNP(J)
INDXPT(K)=J
33
CONTINUE
34
CONTINUE
IPT=4
INDXPT(4)=0
IPT=3
37
J3=I3
J1=I1
J2=I2
J4=I4
CALL AREA
OBTAIN THE INTERSECTION AREA
DO91IJ=1,3
FNST1(IJ)=0.0
VPT(IJ+1) >0
AND
YSTIPO(IJ)≥YBP
FNST1(IJ)=AKST(IJ)*(YSTIPO(IJ)-YBP)
SFNST=SFNST+FNST1(IJ)
91
CONTINUE
IB=1
FNX1=AKV*DELYBP*SDEN
FNX=FNX1+SFNST
NSLCE ≠0
B


CONTINUE
50
CALL RESPRC
AND
100
103
CALCULATE
250
SHOW MESSAGE


26
DO 34 J=1 17
THIS DO LOOP ORDERS THE RETAINED POINTS IN INCREASING VALUES OF LATERAL VELOCITY
IDPT(J)=0
29
DO 33 K=1 4
T
VNP(J) VMAX(K
T
K 4
K1=K+1
30
DO 31 L=K1 4
M=4 L+K1
VMAX(M)=VMAX(M 1)
INDXPT(M)=INDXPT(M 1)
31
CONTINUE
32
VMAX(K)=VNP(J)
INDXPT(K)=J
33
CONTINUE
34
CONTINUE
IPT=4
INDXPT(4)=0
T
IPT=3
37
J3=I3
J1=I1
J2=I2
J4=I4
CALL AREA
OBTAIN THE INTERSECTION AREA
DO91IJ=1,3
FNST(I)=0.0
VPT(IJ+1) >0
AND
YSTIPO(IJ)≥YBP
T
FNST(IJ)=AKST(IJ)*(YSTIPO(IJ)-YBP)
SFNST=SFNST+FNST(IJ)
91
CONTINUE
IB=1
T
FNX1=AKV*DELYBP*SDEN
FNX=FNX1+SFNST
NSLCE≠0
T
B


CALCULATE CONSTANTS FOR THE CURRENT BARRIER PLANE POSITION
THIS DO LOOP CALCULATES INTERCEPTS BETWEEN THE BARRIER PLANE AND THE VEHICLE BY SIMULTANEOUS SOLUTION OF THE INTERSECTION OF TWO VEHICLE PLANES AND THE BARRIER PLANE. LOGIC IS EMPLOYED TO LIMIT THE SOLUTIONS TO POINTS THAT ARE PHYSICALLY POSSIBLE
CALCULATE XMTX
CALL SIMSOL
SET THE INTERSECTION POINT OF THE TWO VEHICLE PLANES AND THE BARRIER
REJECT INTERSECTION POINT IF IT LIES OUTSIDE THE VEHICLE
CONTINUE
IF TEST IS TRUE DECREASE BARRIER DEFORMATION AND START AGAIN
TEST IS TRUE IF INFINITE VERTICAL BARRIER OPTION IS IN EFFECT
CALCULATE CONSTANTS FOR DETERMINING INTERSECTION POINTS OF FINITE VERTICAL BARRIER AND VEHICLE
THIS DO LOOP CALCULATES INTERSECTION POINTS BETWEEN THE BARRIER FACE PLANE, TOP AND BOTTOM PLANES AND VEHICLE PLANES. LOGIC EMPLOYED IS TO ELIMINATE CALCULATION OF PHYSICALLY IMPOSSIBLE INTERSECTIONS
CALCULATE VELOCITY COMPONENTS OF THE RETAINED INTERSECTION POINTS
CALL AREA
OBTAIN THE INTERSECTION AREA

JBROUTINE SUSFRC(DISP,VEL)

. Purpose:

1. This subroutine calculates the suspension forces acting between the sprung and unsprung masses at the four vehicle corners

. Common Blocks Required:

INPT, INPT3, INTG, DIMV, COMP, ADTNL, APTABL,
INSUS, SUSCMP

. Subroutines Required:

INTRPL

. Arguments:

DISP - a four element array containing the suspension displacements
VEL - a four element array containing the suspension velocities

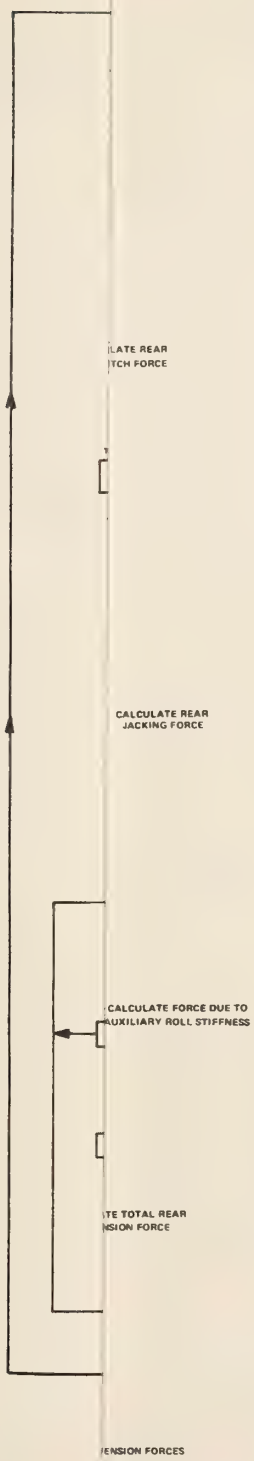
. Common Variables Calculated:

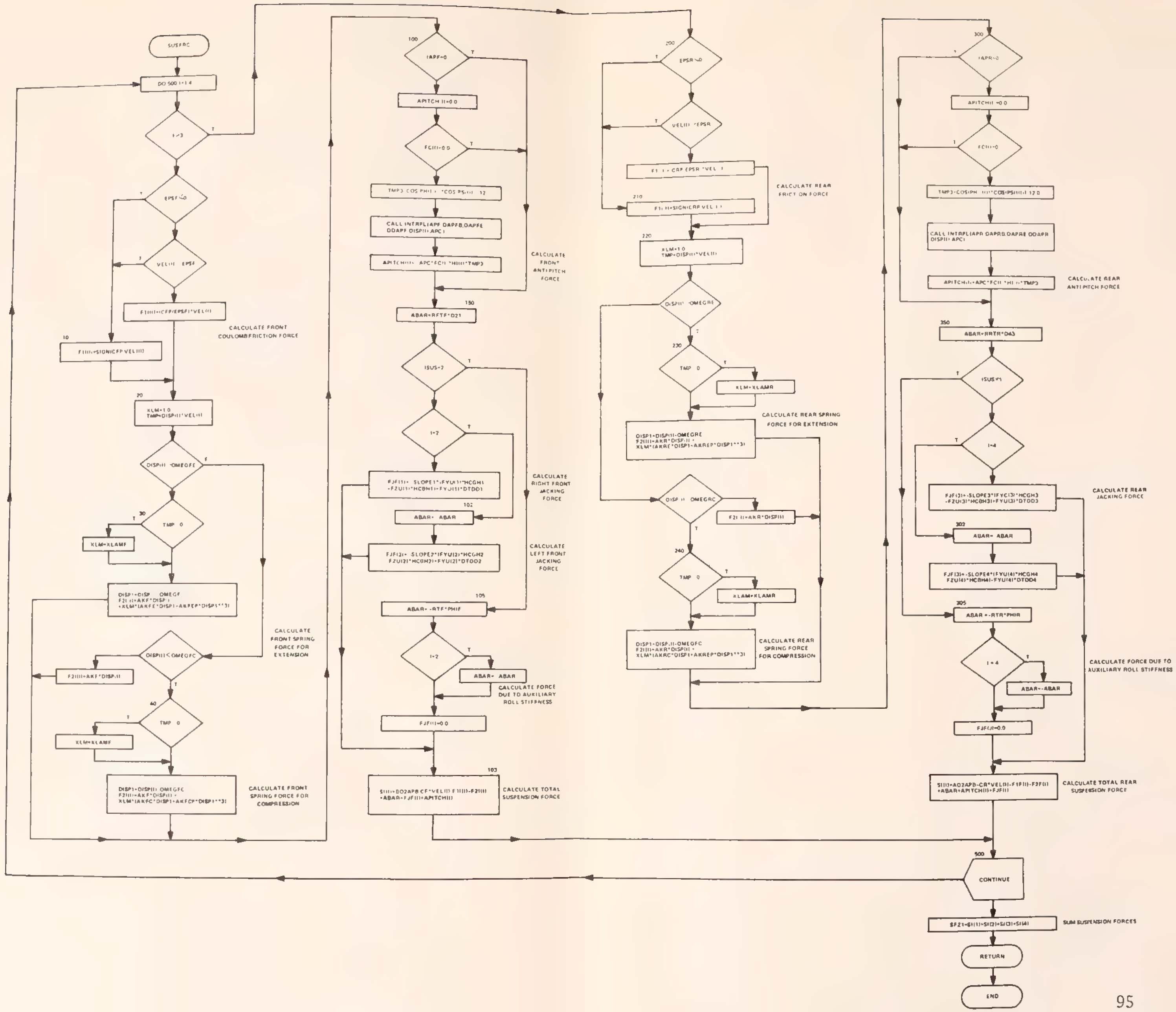
SI, FJF, F1I, F2I, SFZ1, APITCH

. Size:

$7BC)_{16} = 1980)_{10}$ bytes

. Computational Procedure:


LATE REAR
TCH FORCE
CALCULATE REAR
JACKING FORCE
CALCULATE FORCE DUE TO
AUXILIARY ROLL STIFFNESS
TE TOTAL REAR
NSION FORCE
ENSION FORCES



38. SUBROUTINE TEREAD

a. Purpose:

1. This subroutine reads terrain table input cards

b. Common Blocks Required:

INPT

c. Subroutines Required:

None

d. Arguments:

I - Terrain table number
NNBX - Number of X' boundaries
NNBY - Number of Y' boundaries
NNX - Number of X' terrain entries
NNY - Number of Y' terrain entries
NZ5T - Indicator for variable increment table
NERR - Error indicator

e. Common Variables Calculated:

ZGP, XBDRY, YBDRY, PSBDRO, XXZGP5, YYZGP5

f. Size:

$626)_{16} = 1574)_{10}$ bytes

39. SUBROUTINE TIRFRC(J)

a. Purpose:

1. Calculate tire circumferen

b. Common Blocks Required:

DIMV, COMP, COMPN, ADTNL, TIR

c. Subroutines Required:

None

d. Arguments:

The argument, J, indicates the
calculations are made

e. Common Variables Calculated:

FC, FS, FXU, FYU, FZU, BETP, F
FRXU, FRYU, FRZU, FSXU, FSYU,
SFZU, BETBR, CPHIC, PHICI, SPH

f. Size:

$922)_{16} = 2338)_{10}$ bytes

g. Computational Procedure:

SIDE FORCE CALCULATIONS FOR TIRE J OR FOR A PAIR OF TIRES IF ONE TIRE OF THE PAIR IS SPINNING

IF BOTH LATERAL AND LONGITUDINAL VELOCITY COMPONENTS OF THE TIRE ARE SMALL, DO NO COMPUTE A SIDE FORCE.

CALCULATE MAXIMUM AVAILABLE SIDE FORCE

TEST IS TRUE IF THE TIRE IS HEAVILY LOADED

CALCULATE NON-DIMENSIONAL SLIP ANGLE VARIABLE DUE TO CAMBER (BETP) AND NON-DIMENSIONAL SLIP ANGLE (BETBR)

TEST IS FALSE IF SIDE FORCE CAPABILITIES ARE SATURATED.

CALCULATE SIDE FORCE

SINCE FRCP REQUIRE FS, REPEAT ONCE FROM START 2 USING UPDATED FS

39. SUBROUTINE TIRFRC(J)

a. Purpose:

1. Calculate tire circumferential and side forces

b. Common Blocks Required:

DIMV, COMP, COMPN, ADTNL, TIRIN

c. Subroutines Required:

None

d. Arguments:

The argument, J, indicates the wheel number for which calculations are made

e. Common Variables Calculated:

FC, FS, FXU, FYU, FZU, BETP, FCXU, FCYU, FCZU, FRCP, FRXU, FRYU, FRZU, FSXU, FSYU, FSZU, SFXU, SFYU, SFZU, BETBR, CPHIC, PHICI, SPHIC

f. Size:

$922)_{16} = 2338)_{10}$ bytes

g. Computational Procedure:

SIDE FORCE CALCULATIONS FOR TIRE J OR FOR A PAIR OF TIRES IF ONE TIRE OF THE PAIR IS SPINNING

IF BOTH LATERAL AND LONGITUDINAL VELOCITY COMPONENTS OF THE TIRE ARE SMALL, DO NO COMPUTE A SIDE FORCE.

CALCULATE MAXIMUM AVAILABLE SIDE FORCE

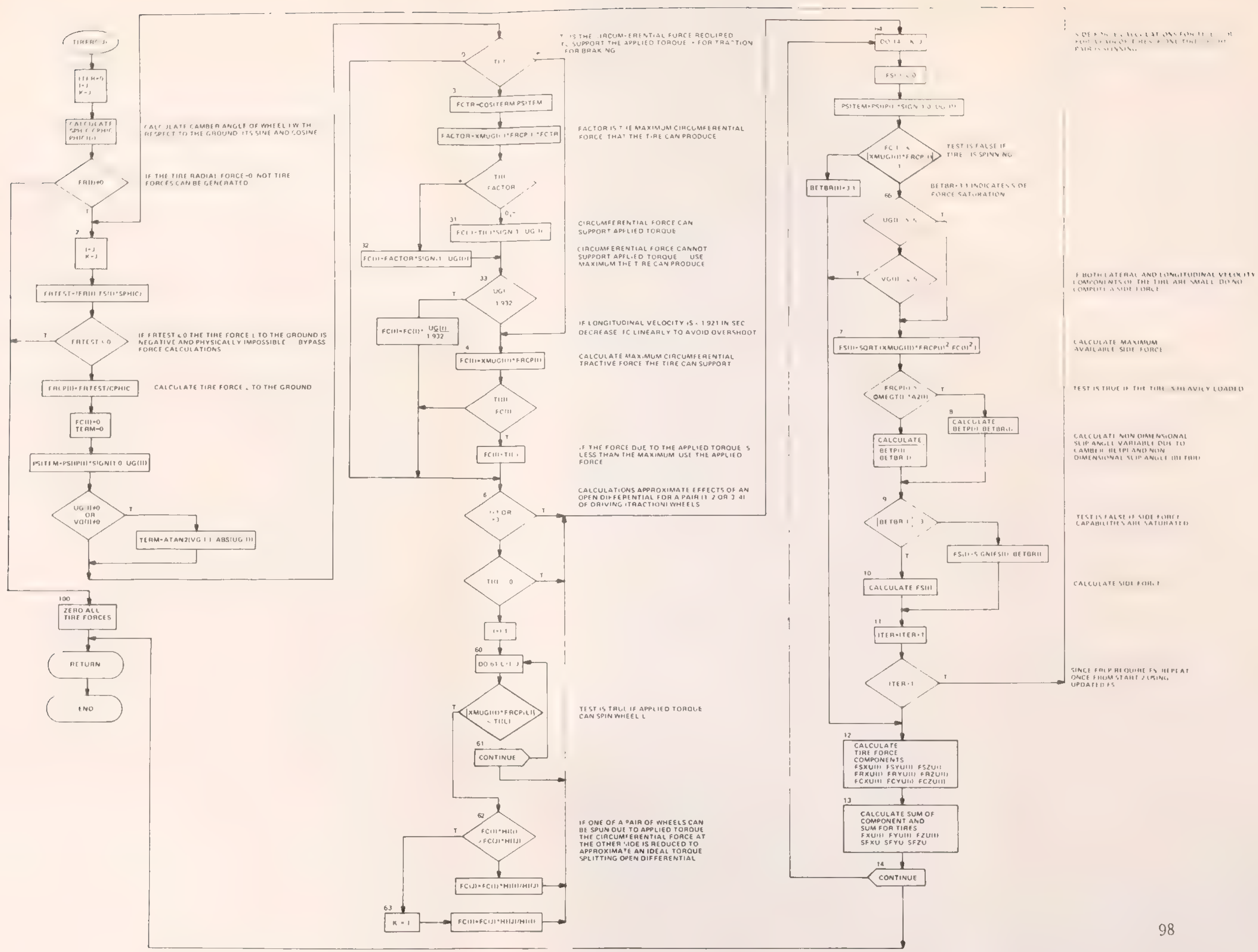
TEST IS TRUE IF THE TIRE IS HEAVILY LOADED

CALCULATE NON-DIMENSIONAL SLIP ANGLE VARIABLE DUE TO CAMBER (BETP) AND NON-DIMENSIONAL SLIP ANGLE (BETBR)

TEST IS FALSE IF SIDE FORCE CAPABILITIES ARE SATURATED.

CALCULATE SIDE FORCE

SINCE FRCP REQUIRE FS, REPEAT ONCE FROM START 2 USING UPDATED FS



CALCULATE CAMBER ANGLE OF WHEEL I WITH RESPECT TO THE GROUND ITS SINE AND COSINE
IF THE TIRE RADIAL FORCE=0 NO TIRE FORCES CAN BE GENERATED
IF FRTEST ≤ 0 THE TIRE FORCE ⊥ TO THE GROUND IS NEGATIVE AND PHYSICALLY IMPOSSIBLE — BYPASS FORCE CALCULATIONS
CALCULATE TIRE FORCE ⊥ TO THE GROUND
ZERO ALL TIRE FORCES
RETURN
END
FCTR=COS(TERM-PSITEM)
FACTOR IS THE MAXIMUM CIRCUMFERENTIAL FORCE THAT THE TIRE CAN PRODUCE
CIRCUMFERENTIAL FORCE CAN SUPPORT APPLIED TORQUE
CIRCUMFERENTIAL FORCE CANNOT SUPPORT APPLIED TORQUE — USE MAXIMUM THE TIRE CAN PRODUCE
IF LONGITUDINAL VELOCITY IS < 1.921 IN SEC DECREASE FC LINEARLY TO AVOID OVERSHOOT
CALCULATE MAXIMUM CIRCUMFERENTIAL TRACTIVE FORCE THE TIRE CAN SUPPORT
IF THE FORCE DUE TO THE APPLIED TORQUE IS LESS THAN THE MAXIMUM USE THE APPLIED FORCE
CALCULATIONS APPROXIMATE EFFECTS OF AN OPEN DIFFERENTIAL FOR A PAIR (1, 2 OR 3, 4) OF DRIVING (TRACTION) WHEELS
CONTINUE
TEST IS TRUE IF APPLIED TORQUE CAN SPIN WHEEL L
IF ONE OF A PAIR OF WHEELS CAN BE SPUN DUE TO APPLIED TORQUE THE CIRCUMFERENTIAL FORCE AT THE OTHER SIDE IS REDUCED TO APPROXIMATE AN IDEAL TORQUE SPLITTING OPEN DIFFERENTIAL
TEST IS FALSE IF TIRE I IS SPINNING
BETBR=1 INDICATES SIDE FORCE SATURATION
IF BOTH LATERAL AND LONGITUDINAL VELOCITY COMPONENTS OF THE TIRE ARE SMALL DO NOT COMPUTE A SIDE FORCE
CALCULATE MAXIMUM AVAILABLE SIDE FORCE
TEST IS TRUE IF THE TIRE IS HEAVILY LOADED
CALCULATE NON DIMENSIONAL SLIP ANGLE VARIABLE DUE TO CAMBER (BETP) AND NON DIMENSIONAL SLIP ANGLE (BETBR)
TEST IS FALSE IF SIDE FORCE CAPABILITIES ARE SATURATED
CALCULATE SIDE FORCE
CALCULATE FS(I)
ITER=ITER+1
SINCE FRCP REQUIRES FS REPEAT ONCE FROM START 2 USING UPDATED FS
CALCULATE TIRE FORCE COMPONENTS
CALCULATE SUM OF COMPONENT AND SUM FOR TIRES

40. SUBROUTINE TMCNST

a. Purpose:

1. Evaluate time dependent va
   other subroutines
2. Test for and index coordin

b. Common Blocks Required:

INPT, INTG, COMP, EINDEX, ADTN

c. Subroutines Required:

None

d. Arguments:

None

e. Common Variables Calculated:

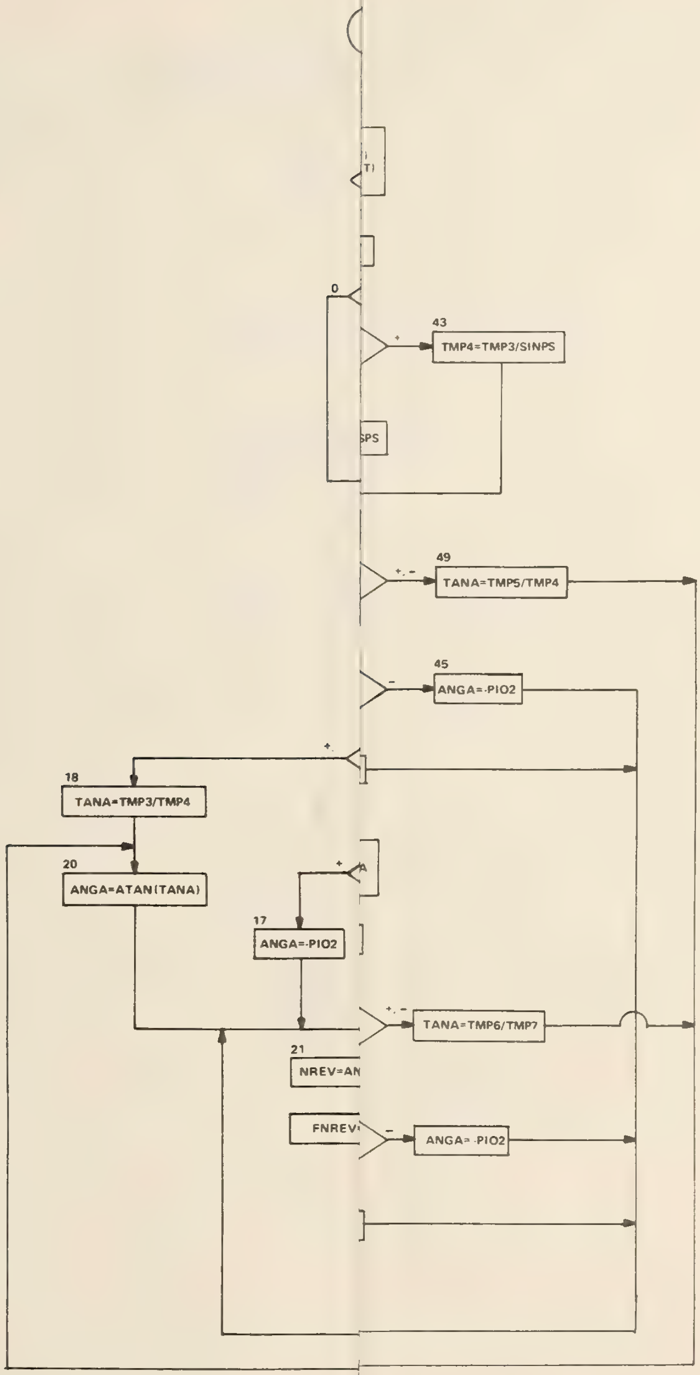
PQ, PR, P2, QR, R2, UQ, UR, VP
D21, D43, RPR, TPF, TPR, GCTH,
PHRP, PSIT, RFPF, TG61, TIZ2,
ZRD3, ZRD4, CNMTX, COSPH, COSP
CPSTP, DD1M2, DD1P2, DD3M4, DD
D3MD4, D3PD4, ISTOP, PHIF2, PH
RPHRD, SECTP, SINPH, SINPS, SI
TANTP, THETT, XINDL, ZFD12, ZF
COSPHN, COSPSN, COSTHN, CTHETP
SINPHN, SINPSN, SINTHN, STHETP

f. Size:

$D36)_{16} = 3382)_{10}$ bytes

g. Computational Procedure:

1. Compute time dependent var
2. Test for coordinate system
   shown below


0
43
TMP4=TMP3/SINPS
SPS
49
TANA=TMP5/TMP4
45
ANGA=-PIO2
18
TANA=TMP3/TMP4
20
ANGA=ATAN(TANA)
17
ANGA=-PIO2
TANA=TMP6/TMP7
21
NREV=AN
FNREV
ANGA=-PIO2

40. SUBROUTINE TMCNST

a. Purpose:

1. Evaluate time dependent variables that are required in other subroutines
2. Test for and index coordinate system if necessary

b. Common Blocks Required:

INPT, INTG, COMP, EINDEX, ADTNL, TIRIN

c. Subroutines Required:

None

d. Arguments:

None

e. Common Variables Calculated:

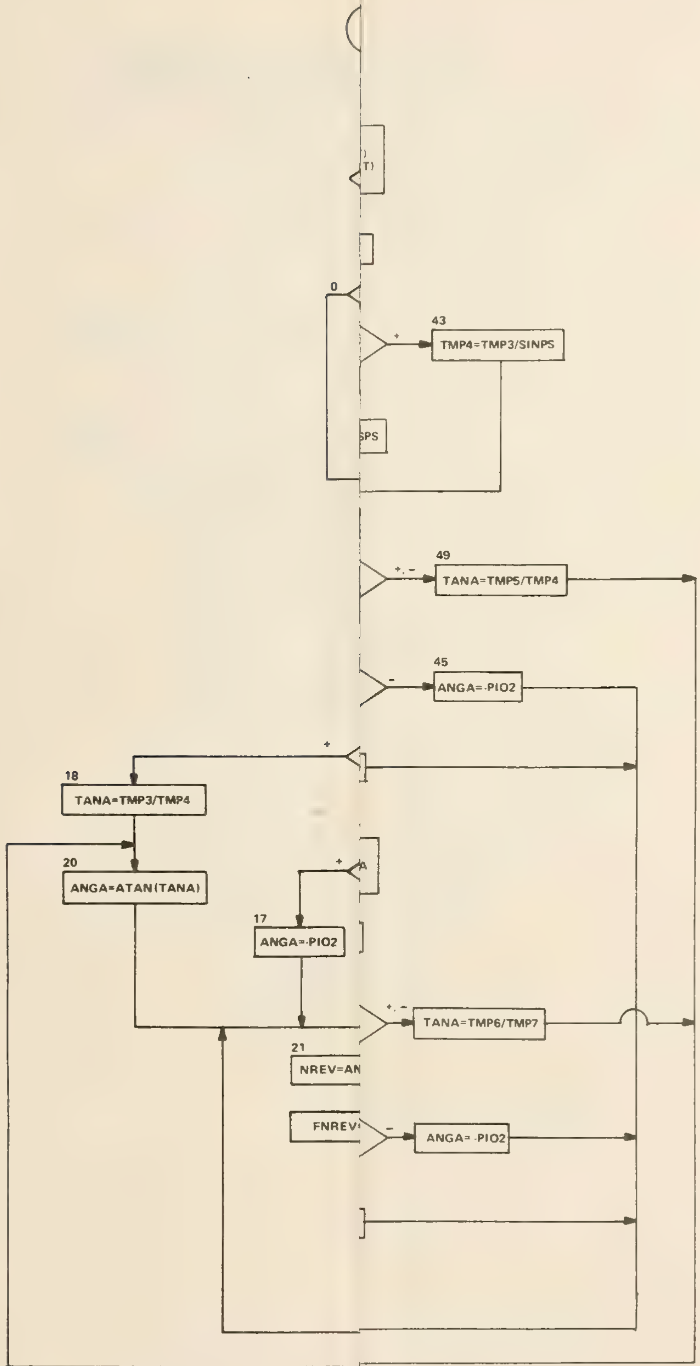
PQ, PR, P2, QR, R2, UQ, UR, VP, VR, WP, WQ, D21, D43, RPR, TPF, TPR, GCTH, GSTH, PHFP, PHIT, PHRP, PSIT, RFPF, TG61, TIZ2, WFMF, ZFD1, ZFD2, ZRD3, ZRD4, CNMTX, COSPH, COSPS, COSTH, CPHTP, CPSTP, DD1M2, DD1P2, DD3M4, DD3P4, D1MD2, D1PD2, D3MD4, D3PD4, ISTOP, PHIF2, PHIR2, RPF2M, RPHFD, RPHRD, SECTP, SINPH, SINPS, SINTH, SPHTP, SPSTP, TANTP, THETT, XINDL, ZFD12, ZFD3R, ZRD3R, ZRD34, COSPHN, COSPSN, COSTHN, CTHETP, PHIFD2, PHIRD2, SINPHN, SINPSN, SINTHN, STHETP, ZFD1RF

f. Size:

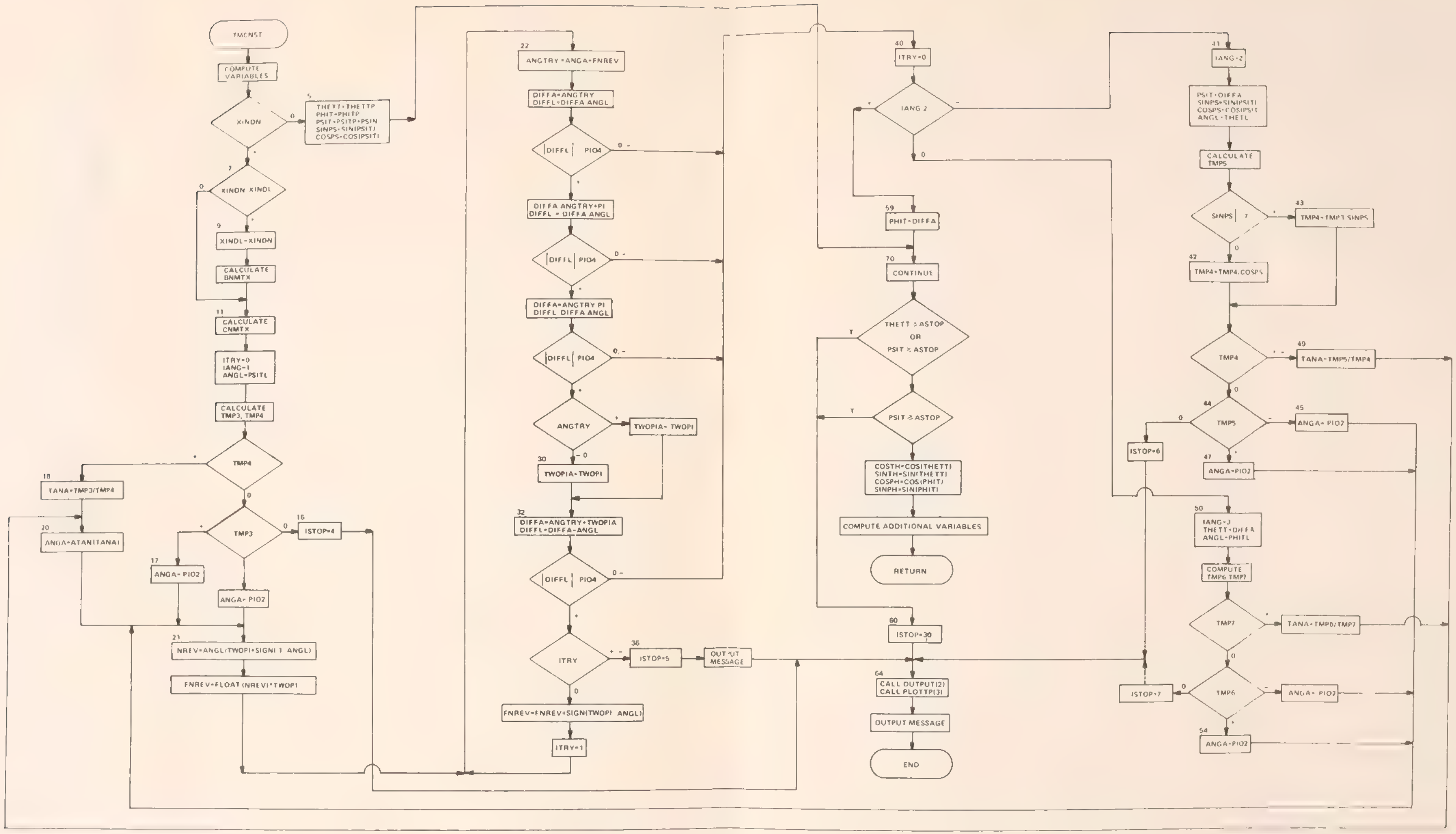
$D36)_{16} = 3382)_{10}$ bytes

g. Computational Procedure:

1. Compute time dependent variables
2. Test for coordinate system indexing; if required as shown below



43
TMP4=TMP3/SINPS
49
TANA=TMP5/TMP4
45
ANGA=-PIO2
18
TANA=TMP3/TMP4
20
ANGA=ATAN(TANA)
17
ANGA=-PIO2
TANA=TMP6/TMP7
21
ANGA=-PIO2



TMCNST
COMPUTE VARIABLES
XINDN
THETT=THETTP
PHIT=PHITP
PSIT=PSITP+PSIN
SINPS=SIN(PSIT)
COSPS=COS(PSIT)
XINDN XINDL
XINDL=XINDN
CALCULATE BNMTX
CALCULATE CNMTX
ITRY=0
IANG=1
ANGL=PSITL
CALCULATE TMP3, TMP4
TMP4
TANA=TMP3/TMP4
ANGA=ATAN(TANA)
TMP3
ISTOP=4
ANGA=PIO2
ANGA=PIO2
NREV=ANGL/TWOPI+SIGN(1 ANGL)
FNREV=FLOAT(NREV)*TWOPI
ANGTRY=ANGA+FNREV
DIFFA=ANGTRY
DIFFL=DIFFA ANGL
|DIFFL| PIO4
DIFFA ANGTRY+PI
DIFFL = DIFFA ANGL
|DIFFL| PIO4
DIFFA=ANGTRY PI
DIFFL DIFFA ANGL
|DIFFL| PIO4
ANGTRY
TWOPIA= TWOPI
TWOPIA=TWOPI
DIFFA=ANGTRY+TWOPIA
DIFFL=DIFFA-ANGL
|DIFFL| PIO4
ITRY
ISTOP=5
OUTPUT MESSAGE
FNREV=FNREV+SIGN(TWOPI ANGL)
ITRY=1
ITRY=0
IANG 2
PHIT=DIFFA
CONTINUE
THETT ≥ ASTOP OR PSIT ≥ ASTOP
PSIT ≥ ASTOP
COSTH=COS(THETT)
SINTH=SIN(THETT)
COSPH=COS(PHIT)
SINPH=SIN(PHIT)
COMPUTE ADDITIONAL VARIABLES
RETURN
ISTOP=30
CALL OUTPUT(2)
CALL PLOTTP(3)
OUTPUT MESSAGE
END
IANG=2
PSIT=DIFFA
SINPS=SIN(PSIT)
COSPS=COS(PSIT)
ANGL=THETL
CALCULATE TMP5
SINPS
TMP4=TMP3 SINPS
TMP4=TMP4.COSPS
TMP4
TANA=TMP5/TMP4
TMP5
ANGA=PIO2
ISTOP=6
ANGA=PIO2
IANG=3
THETT=DIFFA
ANGL=PHITL
COMPUTE TMP6 TMP7
TMP7
TANA=TMP6/TMP7
TMP6
ANGA=PIO2
ISTOP=7
ANGA=PIO2

41. SUBROUTINE TREAD

a. Purpose:

1. This subroutine reads a one-dimensional card input table

b. Common Blocks Required:

None

c. Subroutines Required:

None

d. Arguments:

NCARD - Input card number
NCRDS - Number of cards to be read
NT - Number of elements to be read into the table
NDIM - Maximum table dimension
ARRAY - Table array
NERR - Error indicator

e. Common Variables Calculated:

None

f. Size:

$258)_{16} = 600)_{10}$ bytes

g. Computational Procedure:

1. Read table input cards checking to insure that the table sequence number increases with each card.
2. Load the variables into the table array.

42. SUBROUTINE T2READ

a. Purpose:

1. This subroutine reads a two-dimensional input table.

b. Common Blocks Required:

None

c. Subroutines Required:

None

d. Arguments:

NCARD - Input card number
ND1 - Row dimension of the input table
NI - Number of rows to be read
NJ - Number of columns to be read
ARRAY - Table array
NERR - Error indicator

e. Common Variables Calculated:

None

f. Size:

$2C4)_{16} = 708)_{10}$ bytes

g. Computational Procedure:

The input table is read rowwise with the second subscript varying most rapidly.

43. SUBROUTINE UMOMNT(IS)

a. Purpose:

1. This subroutine calculates the moments acting on the sprung and unsprung masses

b. Common Blocks Required:

INPT, DIMV, COMP, INSUS, SUSCMP

c. Subroutines Required:

None

d. Arguments:

IS - Suspension option indicator

e. Common Variable Calculated:

SNPF, SNPR, SNPU, SNTU, SNPSU, TERM1, TERM2, TERM3

f. Size:

$79C)_{16} = 1948)_{10}$ bytes

g. Computational Procedure:

1. For IS = 0 (independent front, solid axle rear suspension) calculate the sprung mass roll, pitch and yaw moments (SNPU, SNTU, SNPSU) and the rear axle roll moment (SNPR).
2. For IS = 1 (independent front and rear suspension) calculate the sprung mass roll, pitch and yaw moments (SNPU, SNTU, SNPSU).
3. For IS = 2 (solid front and rear axles) calculate the sprung mass roll, pitch and yaw moments (SNPU, SNTU, SNPSU) and the front and rear axle roll moments (SNPF, SNPR).

44. SUBROUTINE VGORNT

a. Purpose:

1. Determine the orientation of the vehicle wheels with respect to the ground
2. Calculate the circumferential tire forces due to applied wheel torques

b. Common Blocks Required:

INPT, INPT1, INTG, DIMV, COMP, COMPN, ADTNL, TIRIN, INSUS, SUSCMP, NEWCRB

c. Subroutines Required:

INTRP5, GCP, CRBIMP, TIRFRC, RUFFRC

d. Arguments:

None

e. Variables Calculated:

AS, AX, AY, BS, BX, BY, CS, CX, CY, D1, D2, D3, P1, P3, P4, P5, P6, P7, TI, UG, VG, V1, V2, V3, V4, W1, W2, W3, W4, CAC, CAH, CAS, CBC, CBH, CBS, CGC, CGH, CGS, CPG, CTG, SPG, STG, CAGZ, CAYW, CAZW, CBGZ, CBYW, CBZW, CGGZ, CGYW, CGZW, CPYG, CTXG, HCAH, HCBH, HCGH, LCB1, LCB2, PHGI, STXG, THGI, TMP3, TMP4, ZPGI, DISTD, DISTS, DISTX, DISTY, PSIIP

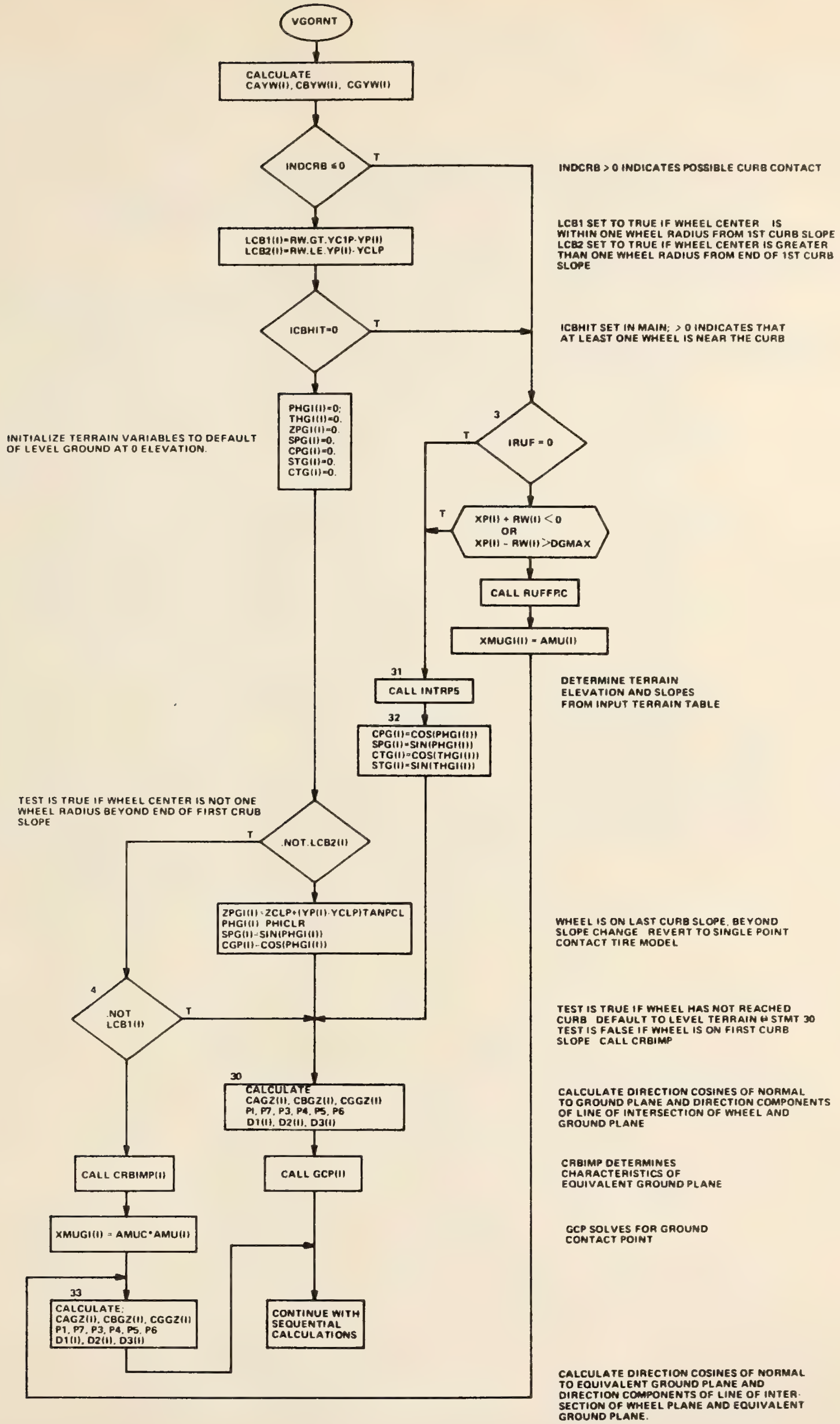
f. Size:

$1028)_{16} = 4136)_{10}$ bytes

g. Computational Procedure:

For wheels I = 1 to 4

1. Calculate the direction cosines of the normal to the wheel plane.
2. Determine the direction cosines of a normal to the ground plane and direction components of the intersection of the wheel plane and ground plane as follows:



VGORNT
CALCULATE CAYW(I), CBYW(I), CGYW(I)
INDCRB ≤ 0
T
INDCRB > 0 INDICATES POSSIBLE CURB CONTACT
LCB1(I)=RW.GT.YC1P-YP(I)
LCB2(I)=RW.LE.YP(I)-YCLP
LCB1 SET TO TRUE IF WHEEL CENTER IS WITHIN ONE WHEEL RADIUS FROM 1ST CURB SLOPE LCB2 SET TO TRUE IF WHEEL CENTER IS GREATER THAN ONE WHEEL RADIUS FROM END OF 1ST CURB SLOPE
ICBHIT=0
T
ICBHIT SET IN MAIN; > 0 INDICATES THAT AT LEAST ONE WHEEL IS NEAR THE CURB
INITIALIZE TERRAIN VARIABLES TO DEFAULT OF LEVEL GROUND AT 0 ELEVATION.
PHGI(I)=0; THGI(I)=0. ZPGI(I)=0. SPG(I)=0. CPG(I)=0. STG(I)=0. CTG(I)=0.
3
IRUF = 0
T
T
XP(I) + RW(I) < 0 OR XP(I) - RW(I) > DGMAX
CALL RUFFRC
XMUGI(I) = AMU(I)
31
CALL INTRP5
DETERMINE TERRAIN ELEVATION AND SLOPES FROM INPUT TERRAIN TABLE
32
CPG(I)=COS(PHGI(I)) SPG(I)=SIN(PHGI(I)) CTG(I)=COS(THGI(I)) STG(I)=SIN(THGI(I))
TEST IS TRUE IF WHEEL CENTER IS NOT ONE WHEEL RADIUS BEYOND END OF FIRST CRUB SLOPE
T
.NOT.LCB2(I)
ZPGI(I)=ZCLP+(YP(I)-YCLP)TANPCL PHGI(I) PHICLR SPG(I)=SIN(PHGI(I)) CGP(I)=COS(PHGI(I))
WHEEL IS ON LAST CURB SLOPE, BEYOND SLOPE CHANGE REVERT TO SINGLE POINT CONTACT TIRE MODEL
4
.NOT LCB1(I)
T
TEST IS TRUE IF WHEEL HAS NOT REACHED CURB DEFAULT TO LEVEL TERRAIN @ STMT 30 TEST IS FALSE IF WHEEL IS ON FIRST CURB SLOPE CALL CRBIMP
30
CALCULATE CAGZ(I), CBGZ(I), CGGZ(I) P1, P7, P3, P4, P5, P6 D1(I), D2(I), D3(I)
CALCULATE DIRECTION COSINES OF NORMAL TO GROUND PLANE AND DIRECTION COMPONENTS OF LINE OF INTERSECTION OF WHEEL AND GROUND PLANE
CALL CRBIMP(I)
CALL GCP(I)
CRBIMP DETERMINES CHARACTERISTICS OF EQUIVALENT GROUND PLANE
XMUGI(I) = AMUC*AMU(I)
GCP SOLVES FOR GROUND CONTACT POINT
33
CALCULATE; CAGZ(I), CBGZ(I), CGGZ(I) P1, P7, P3, P4, P5, P6 D1(I), D2(I), D3(I)
CONTINUE WITH SEQUENTIAL CALCULATIONS
CALCULATE DIRECTION COSINES OF NORMAL TO EQUIVALENT GROUND PLANE AND DIRECTION COMPONENTS OF LINE OF INTERSECTION OF WHEEL PLANE AND EQUIVALENT GROUND PLANE.

3. Calculate the direction cosines of the line of action of the radial tire force with respect to the vehicle axes, CAH(I), CBH(I), CGH(I).
4. Calculate the circumferential tire force due to applied torques, TI(I).
5. Calculate the lateral and vertical velocities of the tire at the ground contact point with components resolved in the vehicle axes, (V1, W1); (V2, W2); (V3, W3); (V4, W4).
6. Calculate the direction components of the vehicle x axis projected into the ground plane, AX(I), BX(I), CX(I).
7. Calculate the sine and cosine of the angle between the vehicle x axis and its projection into the ground plane STXG(I), CTXG(I).
8. Calculate the longitudinal velocity of the tire contact point parallel to the ground plane UG(I).
9. Calculate the direction components of the vehicle y axis projected into the ground plane, AY(I), BY(I), CY(I).
10. Calculate the sine and cosine of the angle between the vehicle y axis and its projection into the ground plane SPYG(I), CPYG(I).
11. Calculate the lateral velocity of the tire contact point parallel to the ground plane, VG(I).
12. Calculate the direction cosines of the steering axis of the wheel.
13. Calculate the steer angle in the ground plane, PSIIP(I).
14. Calculate the direction cosines of the line of action of the circumferential tire force (CAC(I), CBC(I), CGC(I)) and of the tire side force (CAS(I), CBS(I), CGS(I)).
15. Call TIRFRC(I) to obtain magnitudes of side and circumferential tire forces.

45. SUBROUTINE VPOS

a. Purpose:

1. Compute positions, orientations and velocities of the vehicle wheels
2. Calculate torques acting on front and rear wheels
3. Calculate directions of the x and y axis in space

b. Common Blocks Required:

INPT, INPT1, INTG, DIMV, COMP, COMPN, ADTNL, INSUS, SUSCMP

c. Subroutines Required:

INTRPL, DRIVER

d. Arguments:

None

e. Common Variables Calculated:

TI, U1, U2, U3, U4, CAX, CAY, CBX, CBY, CGX, CGY, TQF, TQR, X1P, X2P, X3P, X4P, Y1P, Y2P, Y3P, Y4P, Z1P, Z2P, Z3P, Z4P, PHI1, PHI2, PHI3, PHI4, PSI1, PSI2, PSI3, PSI4, SFXU, SFYU, SFZU, DTDD1, DTDD2, DTDD3, DTDD4, DTHF1, DTHF2, DTHR3, DTHR4, PHI1D, PHI2D, PHI3D, PHI4D, PSIFI, SFYUF, SFYUR, PHIFID, SLOPE1, SLOPE2, SLOPE3, SLOPE4

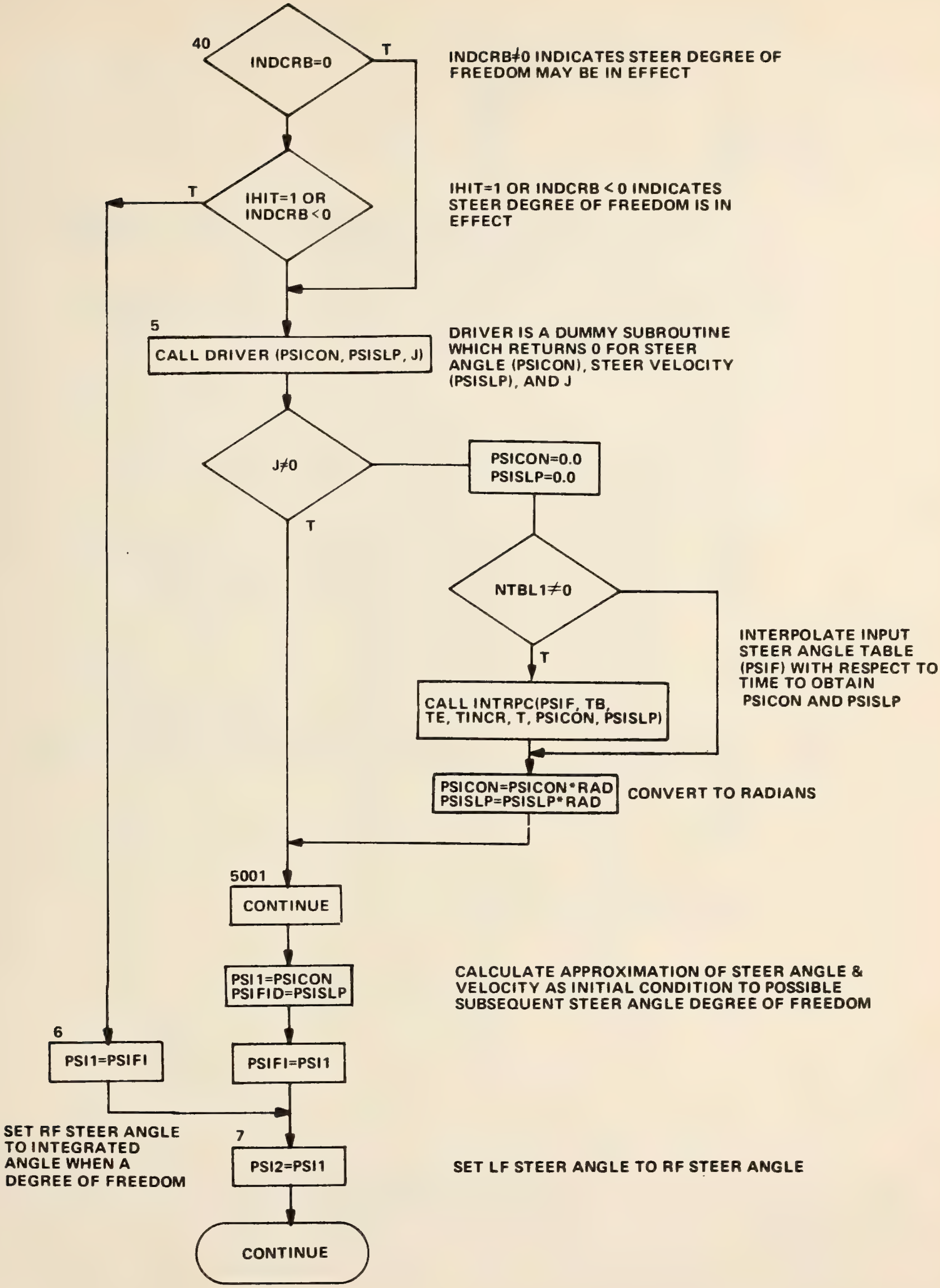
f. Size:

$B50)_{16} = 2896)_{10}$ bytes

g. Computational Procedure:

1. Call INTRPL to interpolate input torque tables TQF, TQR with respect to simulated time, T. TQF yields front wheel torques TI(1), TI(2); TQR yields rear wheel torques TI(3), TI(4).
2. Calculate longitudinal velocities of wheel centers along the vehicle axes, U1, U2, U3, U4. Note that for independent suspension options, INTRPC is called to obtain the track change and rate of track change as a function of suspension position.
3. Zero forces acting on the unsprung masses SFYU = SFXU = SFYUF = SFYUR = SFZU = 0.
4. Calculate AMTX, the transformation matrix from vehicle to space coordinate systems.
5. Calculate direction cosines of the vehicle x and y axis in space (CAX, CBX, CGX and CAY, CBY, CGY).
6. Calculate positions of the wheel centers in space (X1P, Y1P, Z1P); (X2P, Y2P, Z2P); (X3P, Y3P, Z3P); (X4P, Y4P, Z4P).

7. Call INTRPC (entry point in INTRPL) to obtain wheel camber angles and rates of change of camber angles with deflection by interpolation of the input camber tables with respect to suspension deflection for independent suspension options. Note that since the input table of camber is in units of degrees, a conversion to radians is also made.
8. Determine the front wheel steer angle with the following logic.


40
INDCRB=0
T
INDCRB≠0 INDICATES STEER DEGREE OF FREEDOM MAY BE IN EFFECT
T
IHIT=1 OR INDCRB<0
IHIT=1 OR INDCRB < 0 INDICATES STEER DEGREE OF FREEDOM IS IN EFFECT
5
CALL DRIVER (PSICON, PSISLP, J)
DRIVER IS A DUMMY SUBROUTINE WHICH RETURNS 0 FOR STEER ANGLE (PSICON), STEER VELOCITY (PSISLP), AND J
J≠0
T
PSICON=0.0
PSISLP=0.0
NTBL1≠0
T
CALL INTRPC(PSIF, TB, TE, TINCR, T, PSICON, PSISLP)
INTERPOLATE INPUT STEER ANGLE TABLE (PSIF) WITH RESPECT TO TIME TO OBTAIN PSICON AND PSISLP
PSICON=PSICON*RAD
PSISLP=PSISLP*RAD
CONVERT TO RADIANS
5001
CONTINUE
PSI1=PSICON
PSIFID=PSISLP
CALCULATE APPROXIMATION OF STEER ANGLE & VELOCITY AS INITIAL CONDITION TO POSSIBLE SUBSEQUENT STEER ANGLE DEGREE OF FREEDOM
6
PSI1=PSIFI
PSIFI=PSI1
SET RF STEER ANGLE TO INTEGRATED ANGLE WHEN A DEGREE OF FREEDOM
7
PSI2=PSI1
SET LF STEER ANGLE TO RF STEER ANGLE
CONTINUE

46. SUBROUTINE WHEEL

a. Purpose:

1. To calculate equivalent tire radial mode spring rates

b. Common Blocks Required:

None

c. Subroutines Required:

None

d. Arguments:

AKT - Point contact model tire spring rate
SIGT - Point contact model tire deflection at which spring rate increases
XLAMT - Spring rate increase
RWHJB - Beginning deflection for radial spring table
RWHJE - Ending deflection for radial spring table
DRWHJ - Deflection increment for radial spring table
NFJP - Number of radial spring table entries
RW - Undeflected tire radius
FJP - Radial spring force table
NO - Maximum number of entries in radial spring force table

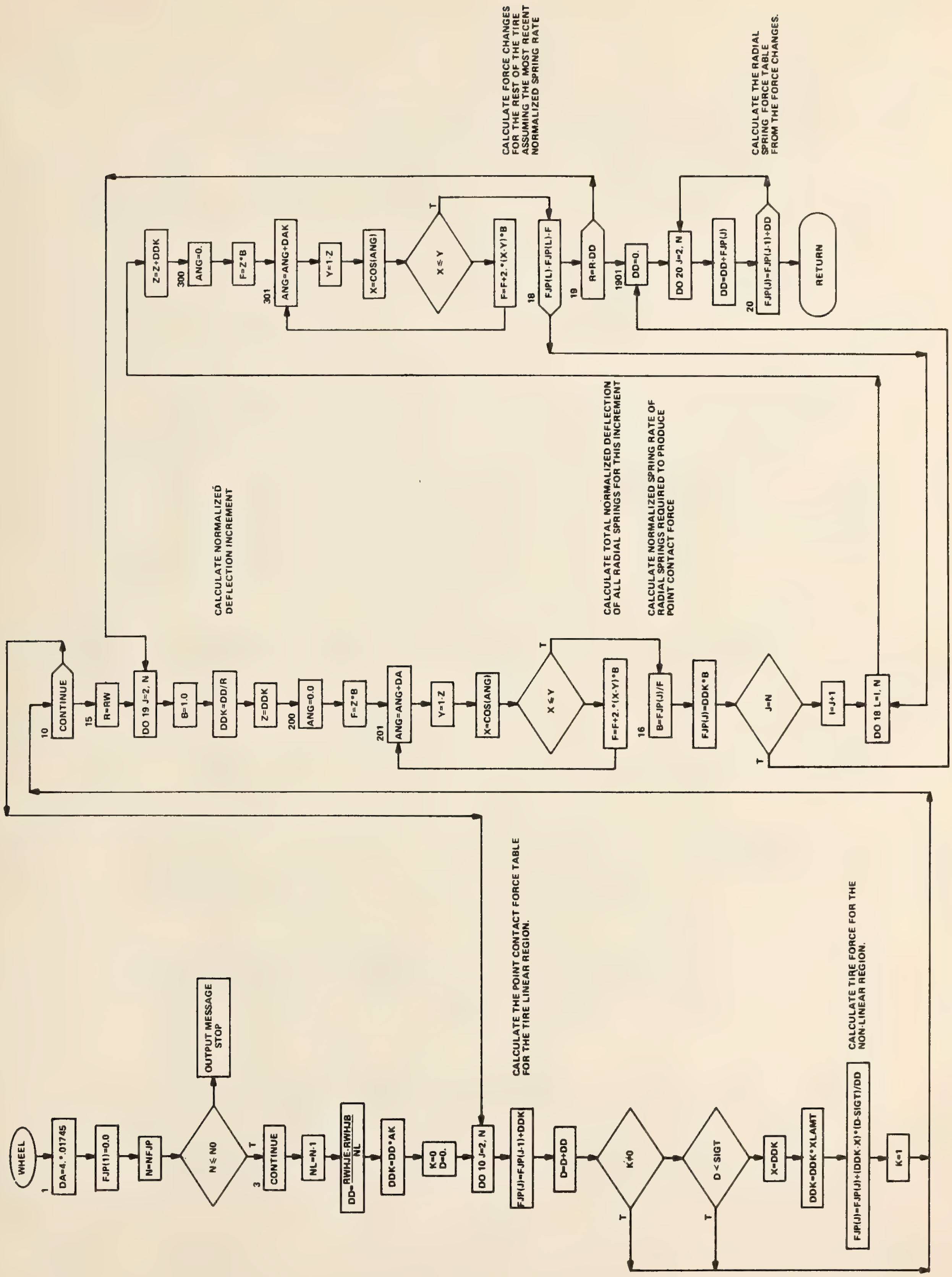
e. Common Variables Calculated:

None

f. Size:

$4FA)_{16} = 1274)_{10}$ bytes

g. Computational Procedure:


WHEEL
1 DA=4.*.01745
FJP(1)=0.0
N=NFJP
N ≤ N0
OUTPUT MESSAGE STOP
3 CONTINUE
NL=N-1
DD=(RWHJE-RWHJB)/NL
DDK=DD*AK
K=0 D=0.
DO 10 J=2, N
FJP(J)=FJP(J-1)+DDK
D=D+DD
K≠0
D < SIGT
X=DDK
DDK=DDK*XLAMT
FJP(J)=FJP(J)+(DDK-X)*(D-SIGT)/DD
K=1
CALCULATE THE POINT CONTACT FORCE TABLE FOR THE TIRE LINEAR REGION.
CALCULATE TIRE FORCE FOR THE NON-LINEAR REGION.
10 CONTINUE
15 R=RW
DO 19 J=2, N
B=1.0
DDK=DD/R
Z=DDK
200 ANG=0.0
F=Z*B
201 ANG=ANG+DA
Y=1-Z
X=COS(ANG)
X ≤ Y
F=F+2.*(X-Y)*B
16 B=FJP(J)/F
FJP(J)=DDK*B
J=N
I=J+1
DO 18 L=I, N
CALCULATE NORMALIZED DEFLECTION INCREMENT
CALCULATE TOTAL NORMALIZED DEFLECTION OF ALL RADIAL SPRINGS FOR THIS INCREMENT
CALCULATE NORMALIZED SPRING RATE OF RADIAL SPRINGS REQUIRED TO PRODUCE POINT CONTACT FORCE
Z=Z+DDK
300 ANG=0.
F=Z*B
301 ANG=ANG+DAK
Y=1-Z
X=COS(ANG)
X ≤ Y
F=F+2.*(X-Y)*B
18 FJP(L)=FJP(L)-F
19 R=R-DD
1901 DD=0.
DO 20 J=2, N
DD=DD+FJP(J)
20 FJP(J)=FJP(J-1)+DD
RETURN
CALCULATE FORCE CHANGES FOR THE REST OF THE TIRE ASSUMING THE MOST RECENT NORMALIZED SPRING RATE
CALCULATE THE RADIAL SPRING FORCE TABLE FROM THE FORCE CHANGES.

3.1.2 HVOSM-RD2 Program Stops and Messages

Program stops include both normal and abnormal stops. Normal stops occur when the cumulative simulated time (T) exceeds the desired final time (T1) as input in field 2 of card 101, or when the magnitudes of both the linear and angular velocities of the vehicle sprung mass are less than or equal to the input minimums (UVWMIN and PQRMIN, card 101, fields 6 and 7). When these stops occur, no message is output and the program attempts to read another set of data cards.

Abnormal stops occur when a condition is encountered that the program is not designed to handle or an unresolvable error has occurred. The first type of abnormal stop occurs when rollover of the vehicle is immenent. That is, when the vehicle has rolled to an angle of 90° in either direction.

The second program stop occurs when the barrier option is in effect (INDB $\neq$ 0) and the vehicle yaw angle (PSIT) is greater than 135°. This stop is necessary since the left rear corner of the vehicle is not tested for contact with the barrier.

Abnormal stops are also indicated by a non-zero value for the variable ISTOP. The following codes identify the type and location of error.

ISTOP = 4 Subroutine TMCNST. The denomenator of the expression used to calculate the value of PSIT after indexing of coordinate system is zero.

ISTOP = 5 Subroutine TMCNST. The logic associated with coordinate system indexing has been unable to determine the correct quadrant for PSIT, PHIT or THETT.

ISTOP = 6 Subroutine TMCNST. The numerator in the expression for calculation of THETT after coordinate system indexing is zero.

ISTOP = 7 Subroutine TMCNST. The numerator in the expression for calculation of PHIT after coordinate system indexing is zero.

ISTOP = 30 Subroutine TMCNST. One of the recalculated Euler angles (PSIT, THETT, PHIT) has been computed as being very large (>3000 radians) after coordinate system indexing. A probable error has occurred.

When an ISTOP $\neq$ 0 condition is encountered, the program prints all output up to the time of the error, prints the value of ISTOP, terminates execution of the current run and attempts to read another set of data cards.

In subroutine INPUT, the following messages are printed if difficulties are encountered in reading the card data deck.

UNEXPECTED END OF FILE ENCOUNTERED IN STMT NO. 1 OF SUBROUTINE INPUT. LAST CARD READ WAS XXXX.

A CARD NUMBERED LESS THAN OR EQUAL TO ZERO WAS ENCOUNTERED IN SUBROUTINE INPUT. CARD IMAGE PRINTED ABOVE.

THE NUMBER OF CARDS READ IS ZERO.

A BLOCK NUMBER OF LESS THAN OR EQUAL TO ZERO HAS BEEN OBTAINED.

A BLOCK NUMBER LARGER THAN THE ALLOWED NUMBER HAS BEEN OBTAINED.

```
AN ERROR HAS OCCURRED IN STORING INPUT VALUES IN ONE
OF THE BLKXX SUBROUTINES.  THE CALLING ARGUMENTS
FROM INPUT ARE:  NBLK = XXXX   NBCRD = XXXX
NSEQ = XXXX   NCARD = XXXX   NERR = XXXX
```

In subroutine NLDFL, messages may be printed if the program determines that both constraints on the unloading curve (the input ratio of conserved to total energy, CONS, and the ratio of maximum to permanent displacement, SET) cannot be simultaneously satisfied. If this occurs, the energy ratio, CONS, is modified and a diagnostic is output.

In subroutine RUFRED, two messages may be printed if difficulties are encountered in reading road roughness data from FORTRAN device 4. They are:

```
END OF FILE ENCOUNTERED IN READ OF ROUGHNESS DATA
BEFORE NEND POINTS WERE READ.

NUMBER OF LAST ROUGHNESS DATA POINT IS GREATER THAN
THE ALLOWED 2200.  PROGRAM TERMINATED.
```

3.1.3 HVOSM-RD2 Program Listing

```
C          HIGHWAY VEHICLE OBJECT SIMULATION MODEL                         MAIN0010
C            MAIN ROUTINE                                                  MAIN0020
C            HVOSM-RD2 VERSION                                             MAIN0030
C            REVISED OCTOBER 1975  CALSPAN CORPORATION                     MAIN0040
      COMMON/HEAD/ VHED(20),CHED(20),GHED(20),SHED(20),THED(20),          MAIN0050
     1            NPAGE(20)                                                MAIN0060
      COMMON/INPT/PHIO,THETAO,PSIO,PO,QO,RO,XCOP,YCOP,ZCOP,UO,VO,WO,      MAIN0070
     1           A,B,DEL10,DEL20,DEL30,PHIRO,DEL10D,DEL20D,DEL30D,        MAIN0080
     2           PHIROD,TF,TR,ZF,ZR,RHO,AKRS,XMUR,                        MAIN0090
     3           XMS,XMUF,XIX,XIY,XIZ,XIXZ,CF,AKF,XLAMF,OMEGF,CFP,EPSF,MAIN0100
     4           RF,CR,AKR,XLAMR,OMEGR,CRP,EPSR,RR,TS,THMAX,DTCOMP,TO,    MAIN0110
     5           T1,DTCMP1,DTPRNT,MODE,EBAR,EM,AAA,HMAX,HMIN,BET,G,       MAIN0120
     6           HED(36),DADE(3),XIR,X1,Y1,Z1,X2,Y2,Z2,PHIC(50),DELB,     MAIN0130
     7           DELE,DDEL,NDEL,PSIF(50),TQF(50),TQR(50),TB,TE,TINCR,     MAIN0140
     8           NZTAB,NZ5,XBDRY(4,5),PSBDRY(4,5),YBDRY(2,5),NBX(5),      MAIN0150
     9           NBY(5),NTBL1,NTBL2,NTBL3,ZGP(21,21,5)                    MAIN0160
      COMMON/INPT/XB(5),XE(5),XINCR(5),NX(5),YB(5),YE(5),YINCR(5),NY(5),MAIN0170
     1         XXZGP5(21),YYZGP5(21),AMUG(5),PSBDRO(4,5),UVWMIN,PQRMIN   MAIN0180
      COMMON/INPT1/YC1P,YC2P,ZC2P,DELTC,PHIC1,PHIC2,AMUC,XIPS,            MAIN0190
     1            CPSP,OMGPS,AKPS,EPSPS,XPS,RWHJB,RWHJE,DRWHJ,INDCRB,     MAIN0200
     2            PSIFIO,PSIFDO                                           MAIN0210
      DIMENSION YCIP(2)                                                    MAIN0220
      EQUIVALENCE (YCIP(1),YC1P)                                          MAIN0230
      COMMON /INTG/NEQ,T,DT,VAR(50),DER(50)                               MAIN0240
      EQUIVALENCE (U,VAR(1)),(V,VAR(2)),(W,VAR(3)),(P,VAR(4)),(Q,VAR(5))MAIN0250
     1         ,(R,VAR(6)),(DEL1,VAR(7)),(DEL1D,VAR(8)),(DEL2,VAR(9)),MAIN0260
     2           (DEL2D,VAR(10)),(DEL3,VAR(11)),(DEL3D,VAR(12)),          MAIN0270
     3           (PHIR,VAR(13)),(PHIRD,VAR(14)),(THETTP,VAR(15)),         MAIN0280
     4           (PHITP,VAR(16)),(PSITP,VAR(17)),(XCP,VAR(18)),           MAIN0290
     5           (YCP,VAR(19)),(ZCP,VAR(20)),(PSIFI,VAR(21)),             MAIN0300
     6           (PSIFID,VAR(22))                                         MAIN0310
      EQUIVALENCE (DU,DER(1)),(DV,DER(2)),(DW,DER(3)),(DP,DER(4)),        MAIN0320
     1           (DQ,DER(5)),(DR,DER(6)),(DDEL1,DER(7)),(DDEL1D,DER(8))MAIN0330
     2         ,(DDEL2,DER(9)),(DDEL2D,DER(10)),(DDEL3,DER(11)),          MAIN0340
     3           (DDEL3D,DER(12)),(DPHIR,DER(13)),(DPHIRD,DER(14)),       MAIN0350
     4           (DTHTTP,DER(15)),(DPHITP,DER(16)),(DPSITP,DER(17)),      MAIN0360
     5           (DXCP,DER(18)),(DYCP,DER(19)),(DZCP,DER(20)),            MAIN0370
     6           (DPSIFI,DER(21)),(DDPSFI,DER(22))                        MAIN0380
      EQUIVALENCE (VAR(9),PHIF),(VAR(10),PHIFD),(DER(9),DPHIF),           MAIN0390
     1           (DER(10),DPHIFD)                                         MAIN0400
      EQUIVALENCE (VAR(13),DEL4),(VAR(14),DEL4D),(DER(13),DDEL4),         MAIN0410
     1           (DER(14),DDEL4D)                                         MAIN0420
      COMMON /DIMV/X1P,X2P,X3P,X4P,Y1P,Y2P,Y3P,Y4P,Z1P,Z2P,Z3P,Z4P,PHI1,MAIN0430
     1            PHI2,PHI3,PHI4,PSI1,PSI2,PSI3,PSI4,CAYW(4),CBYW(4),     MAIN0440
     2            CGYW(4),ZPGI(4),THGI(4),PHGI(4),CPG(4),SPG(4),CTG(4),MAIN0450
     3            STG(4),CAGZ(4),CBGZ(4),CGGZ(4),D1(4),D2(4),D3(4),       MAIN0460
     4            XLM1(4),XLM2(4),XLM3(4),AMTX(3,3),CMTX(3,4),XGPP(4),    MAIN0470
     5            YGPP(4),ZGPP(4),DMATX(10,11),DELTA(4),CAR(4),CBR(4),    MAIN0480
     6            CGR(4),FR(4),HI(4),FC(4),TI(4),AX(4),BX(4),CX(4),       MAIN0490
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     7              CTXG(4),UG(4),STXG(4),AY(4),BY(4),CY(4),CPYG(4),        MAIN0500
     8              SPYG(4),VG(4),PSIIP(4),PHICI(4),CAC(4),CBC(4),CGC(4),MAIN0510
     9              FCXU(4),FCYU(4),FCZU(4),FS(4),CAXW(4),CBXW(4),CGXW(4)MAIN0520
      COMMON /DIMV/AS(4),BS(4),CS(4),CAS(4),CBS(4),CGS(4),BETP(4),          MAIN0530
     1              BETBR(4),FSXU(4),FSYU(4),FSZU(4),FRXU(4),FRYU(4),        MAIN0540
     2              FRZU(4),FXU(4),FYU(4),FZU(4),SI(4),F1FI(2),F1RI(2),      MAIN0550
     3              F2FI(2),F2RI(2),CAH(4),CBH(4),CGH(4)                     MAIN0560
      DIMENSION XP(4),YP(4),ZP(4),PHII(4),PSII(4)                           MAIN0570
      EQUIVALENCE (XP(1),X1P),(YP(1),Y1P),(ZP(1),Z1P),(PHII(1),PHI1),       MAIN0580
     1              (PSII(1),PSI1)                                           MAIN0590
      COMMON /COMP/SUMM,THETN,PHIN,PSIN,PI,RAD,GAM1,GAM2,GAM3,GAM4,GAM5,MAIN0600
     1             GAM6,GAM7,GAM8,GAM9,THETT,PHIT,PSIT,ZRO,TRO2,            MAIN0610
     2              TFO2,TIZ,RHO2,RHOMUR,AMUF,BMUR,ZPR,TM4,RHMR2,AO2APB,     MAIN0620
     3              BO2APB,RFTF,TSO2,RRTS,BROMUR,XMUFO2,AXMFO2,XMTFO4,       MAIN0630
     4              XIZR,RTR,RHMR2I,XIXP,XIZP,XIXZP,XIYZP,D1PD2,D1MD2,       MAIN0640
     5              ZRD3,ZRD3R,ZFD3R,ZFD12,TIZ2,TG61,DD1P2,DD1M2,RPR,PHRPMAIN0650
     6             ,TANTP,SPHTP,CPHTP,SECTP,SFXS,SFYS,SFZS,SNPS,SNTS,        MAIN0660
     7              SNPSS,TPR,CAY,CBY,CGY,CAX,CBX,CGX,SFYU,SFXU,SFYUF,       MAIN0670
     8              SFYUR,SFZU,COSTH,SINTH,COSPS,SINPS,COSPH,SINPH,ANG1,     MAIN0680
     9              ANG2,CPHI,SPHI,CPSI,SPSI,P1,P7,P3,P4,P5,P6,TX,TY,TZ      MAIN0690
      COMMON /COMP/TRH,DISTX,DISTY,DISTD,DISTS,D21,ZETA4,ZETA4D,ZETA3,      MAIN0700
     1              ZETA3D,SFZ1,SNPU,SNTU,HCGH1,HCGH2,HCGH3,HCGH4,TERM1,     MAIN0710
     2              TERM2,SNPSU,SNPR,HCBH1,HCBH2,HCBH3,HCBH4,HCAH1,HCAH2,MAIN0720
     3              HCAH3,HCAH4,UQ,WP,UR,QR,VP,PR,P2,Q2,R2,VR,WQ,PQ,PHIR2MAIN0730
     4             ,PHIRD2,RPHRD,GCTH,GSTH,GCTSP,GCTCP,XXX,YYY,IX,IY,XX1,MAIN0740
     5              XX2,YY1,YY2,THG1,THG2,PHG1,PHG2,ZZ1,ZZ2,LLL              MAIN0750
      DIMENSION HCAH(4),HCBH(4),HCGH(4)                                     MAIN0760
      EQUIVALENCE (HCAH(1),HCAH1),(HCBH(1),HCBH1),(HCGH(1),HCGH1)           MAIN0770
      COMMON /COMPN/ FRSP(4),FRCP(4),ICBHIT,JCBHIT,                         MAIN0780
     1                DPSINT,TANPC1,TANPC2,PHIC1R,PHIC2R,AMUCMP,PHI1D,      MAIN0790
     2                PHI2D,LCB1(4),LCB2(4),IHIT,AJMTX(3,3),BMTX(3,3),      MAIN0800
     3                SFRX(4),SFRY(4),SFRZ(4),T1PSI,T2PSI,XMUGI(4)          MAIN0810
      LOGICAL LCB1,LCB2                                                     MAIN0820
C      COMMON/EINDEX/ FOR EULER ANGLE INDEXING,MAIN,CNSTNT,DAUX,TMCNST      MAIN0830
      COMMON/EINDEX/ TWOPI,PIO2,PIO4,XINDN,XINDL,THETTL,PHITL,PSITL,        MAIN0840
     1                COSTHN,SINTHN,COSPSN,SINPSN,COSPHN,SINPHN,CTHETP,     MAIN0850
     2                STHETP,CPSTP,SPSTP,BNMTX(3,3), CNMTX(3,3),ENDEIN      MAIN0860
      COMMON/ADTNL/ U1,U2,U3,U4,V1,V2,V3,V4,W1,W2,W3,W4,                    MAIN0870
     1               XIYP,SPHIC,CPHIC,APTCH1,APTCH2,APTCH3,APTCH4,          MAIN0880
     2               SLOPE1,SLOPE2,XTRA(300)                                MAIN0890
      DIMENSION UI(4),VI(4),WI(4)                                           MAIN0900
      EQUIVALENCE (UI(1),U1),(VI(1),V1),(WI(1),W1)                          MAIN0910
      DIMENSION APITCH(4)                                                   MAIN0920
      EQUIVALENCE (APITCH(1),APTCH1)                                        MAIN0930
      COMMON /INPT2/ YBPO,ZBTP,ZBBP,XVF,XVR,YV,ZVT,ZVB,AKV,SIGR(11),        MAIN0940
     1                SET,CONS,AMUB,EPSV,EPSB,XM,EPST,DDD,INDB,DELYBP,      MAIN0950
     2                DELTB,XINPT(100)                                      MAIN0960
      COMMON/INPT3/ AKFC,AKFCP,OMEGFC,AKFE,AKFEP,OMEGFE,AKRC,AKRCP,         MAIN0970
     1               OMEGRC,AKRE,AKREP,OMEGRE,END3                          MAIN0980
      COMMON /TIRIN/ AKT(4),SIGT(4),XLAMT(4),A0(4),A1(4),A2(4),A3(4),       MAIN0990
     1                A4(4),OMEGT(4),AMU(4),RW(4),FJP(35,4),A234(4),        MAIN1000
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     2              A12(4),OMT2A2(4),OMT2M1(4),A23(4),ITIR(4)         MAIN1010
      COMMON/BARIER/FN,IBHIT,JBHIT,XCPNP(3),YCPNP(3),ZCPNP(3),XCPN(3), MAIN1020
     1             YCPN(3),ZCPN(3),AA1(17),BB1(17),CC1(17),RR1(17),   MAIN1030
     2             AA2(17),BB2(17),CC2(17),RR2(17),CAB,CBB,CGB,CABT,  MAIN1040
     3             CBBT,CGBT,RB,XBT,YBT,ZBT,XBB,YBB,ZBB,RR2P(17),     MAIN1050
     4             YBPT,XNN(17),YNN(17),ZNN(17),XMTX(3,4),IDPT(17),IPT MAIN1060
     5             ,ININD,UNP(17),VNP(17),WNP(17),VMAX(4),I1,I2,I3,I4, MAIN1070
     6             XCPTP,YCPTP,ZCPTP,XCPBP,YCPBP,ZCPBP,YCPMP,AINTI,   MAIN1080
     7             AINTP,SXR,SYR,SZR,SDEN,XRI,YRI,ZRI,FRICT,DELBB,VTAN,MAIN1090
     8             FNP,FB,URP,VRP,WRP,EPSL,XLDP,DELX,VL,NCYC,EEE,ENRGY,MAIN1100
     9             NSEG,YBPTP,PCAB,PCBB,PCGB,PPRB,CAB1,CBB1,CGB1,     MAIN1110
     A             RB1,NUNLD,NLDCTR,VDEF,PVDEF,PSZR,XF,DELBBP,        MAIN1120
     B             SWORK,SPENGY,DISS,IPLN,ILOAD                       MAIN1130
      DIMENSION INDXPT(4)                                             MAIN1140
      EQUIVALENCE (INDXPT(1),I1)                                      MAIN1150
      COMMON/APTABL/ APFR(21,2),IAPFR(2),DAPFB,DAPFE,DDAPF,NAPF,      MAIN1160
     1              DAPRB,DAPRE,DDAPR,NAPR                            MAIN1170
      DIMENSION APF(21),APR(21)                                       MAIN1180
      EQUIVALENCE (APFR(1,1),APF(1)),(APFR(1,2),APR(1))               MAIN1190
      COMMON /INSUS/ XIF,RHOF,TSF,PHIFO,PHIFOD,DEL40,DEL40D,ISUS,     MAIN1200
     1              AKDS,AKDS1,AKDS2,AKDS3,PHIRC(50),DTHF(50),DTHR(50),MAIN1210
     2              NCAMF,NCAMR,NDTHF,NDTHR                           MAIN1220
      COMMON /SUSCMP/ XMURO2,BXMRO2,XMTRO4,ZFO,TSFO2,RHOF2,RHFMUF,    MAIN1230
     1               RHF2MF,RF2MFI,RTF,RRTR,D3PD4,D3MD4,D43,DD3P4,    MAIN1240
     2               DD3M4,ZFD1RF,ZRD34,RFPF,RPF2M,WFMF,PHFP,PHIF2,   MAIN1250
     3               PHIFD2,RPHFD,ZFD1,ZFD2,ZRD4,TPF,SLOPE3,SLOPE4,   MAIN1260
     4               PHI3D,PHI4D,DTHF1,DTHF2,DTHR3,DTHR4,DTDD1,       MAIN1270
     5               DTDD2,DTDD3,DTDD4,FJF(4),SNPF                    MAIN1280
      COMMON/NEWCRB/ YC3P,YC4P,YC5P,YC6P,YCLP,                        MAIN1290
     1              ZC3P,ZC4P,ZC5P,ZC6P,ZCLP,                         MAIN1300
     2              PHIC3,PHIC4,PHIC5,PHIC6,NCRBSL,                   MAIN1310
     3              TANPC3,TANPC4,TANPC5,TANPC6,TANPCL,               MAIN1320
     4              PHIC3R,PHIC4R,PHIC5R,PHIC6R,PHICLR,               MAIN1330
     5              YCMP(6),ZCMP(6),PHICM(6)                          MAIN1340
      COMMON/BARSTR/XSTIO(3),YSTIO(3),ZSTIO(3),XSTI(3),YSTI(3),       MAIN1350
     1             ZSTI(3),YSTIPO(3),XSTIP(3),YSTIP(3),ZSTIP(3),      MAIN1360
     2             FNSTI(3),AKST(3)                                   MAIN1370
      COMMON/HARDPT/ FRICF(4),UPT(4),VPT(4),WPT(4)                    MAIN1380
      COMMON /RUFNES/ DELG,DGMAX,NEND,IRUF                            MAIN1390
C                                                                     MAIN1400
      COMMON/DRIVTT/ IPATHT,IDRIVE                                    MAIN1410
      COMMON/DRIVI/ DELPTH,XVP,GAIN,YPPE,NPPIO,YPPIO(4),SPI(30)       MAIN1420
      COMMON/NSTOP/ISTOP                                              MAIN1430
      DIMENSION FJPP(35)                                              MAIN1440
C                                                                     MAIN1450
C        SUBROUTINES DVDCHK AND DATE ARE RELATED TO THE OPERATING SYSTEMMAIN1460
C             AT OUR INSTALLATION                                     MAIN1470
C       SUBROUTINE DVDCHK CAN CAUSE HALT ON ATTEMPTED DIVIDE BY ZERO, MAIN1480
C           EXPONENT OVERFLOW, AND MESSAGE ON EXPONENT UNDERFLOW.     MAIN1490
C         THE SERVICES GIVEN BY SUBROUTINE DVDCHK CAN NOW GIVEN BY    MAIN1500
C             FORTRAN EXTENDED ERROR HANDLING                         MAIN1510
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C        SUBROUTINE DATE RETURNS THE CURRENT DATE IN EIGHT  CHARACTERS.
C
      CALL CLEAR(VHED(1),NPAGE(20))
      CALL CLEAR(DELPTH,SPI(30))
      CALL CLEAR(PHIO,PQRMIN)
      CALL CLEAR(YC1P,PSIFDO)
      CALL CLEAR(YBPO,XINPT(100))
      CALL CLEAR( AKFC,END3)
      CALL CLEAR(APFR(1,1),NAPR)
      CALL CLEAR(AKT(1),FJP(35,4))
      CALL CLEAR(ITIR(1),ITIR(4))
      CALL CLEAR(XIF,NDTHR)
      CALL CLEAR(YC3P,PHICM(6))
      CALL CLEAR(XSTIO(1),AKST(3))
      CALL CLEAR(DELG,IRUF)
      IPATHT = 0
      IDRIVE = 0
C       SET IDRIVE=1 IN DRIVID, AT START OF COMPUTATION, IF USING DRIVER
C     SUBROUTINE DRIVID  IS CALLED BY SUBROUTINE IDOUT
      CALL DVDCHK
    1 CALL CLEAR(NEQ,DER(50))
      CALL CLEAR(SUMM,LLL)
      CALL CLEAR(FRSP(1),FRCP(4))
      CALL CLEAR(DPSINT,XMUGI(4))
      CALL CLEAR(XINDN,ENDEIN)
      CALL CLEAR(U1,XTRA(300))
      CALL CLEAR(X1P,CGH(4))
      CALL CLEAR(FN,ILOAD)
      CALL CLEAR(A234(1),A23(4))
      CALL CLEAR(XMURO2,SNPF)
      ISTOP = 0
      CALL INPUT
      CALL DATE(DADE)
      IF(IRUF.NE.0) CALL RUFRED(NEND,DELG,DGMAX,ZGP)
      IF(INDCRB.NE.1.AND.IRUF.EQ.0) GO TO 10
      NFJP = (RWHJE-RWHJB)/DRWHJ + 1.2
      DO 11 I=1,4
      IF(I.EQ.1) GO TO 12
      IM = I-1
      DO 15 K=1,IM
      IF(ITIR(I).EQ.ITIR(K)) GO TO 16
   15 CONTINUE
   12 CALL WHEEL(AKT(I),SIGT(I),XLAMT(I),RWHJB,RWHJE,DRWHJ,NFJP,
     1           RW(I),FJPP,35)
      DO 13 J=1,NFJP
   13 FJP(J,I) = FJPP(J)
      GO TO 11
   16 DO 17 J=1,NFJP
   17 FJP(J,I) = FJP(J,K)
   11 CONTINUE
   10 CONTINUE
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      IF(ZF.EQ.0.0.AND.ZR.EQ.0.0) CALL INITEQ
      CALL IDOUT
      CALL CNSTNT
  100 DO 101  I=1,4
      LCB1(I) = .FALSE.
      LCB2(I) = .FALSE.
  101 CONTINUE
      PIO2 = .5*PI
      TPRINT = TO
      TPATH = TO
      THETMX = ABS(THMAX) * RAD
      UVWM2 = UVWMIN**2
      PQRM2 = PQRMIN**2
       UVWM2 = SIGN(UVWM2,UVWMIN)
       PQRM2 = SIGN(PQRM2,PQRMIN)
      ICBHIT = 0
      JCBHIT = 0
      IHIT = 0
      IBHIT = 0
      JBHIT = 0
      IND = 0
      T = TO
      DT = DTCOMP
      NEQ = 22
      PSIMAX = 135.0*RAD
      CALL PLOTTP(1)
      CALL OUTPUT(0)
    2 CALL PINT1(1,MODE,NEQ,T,DT,U,DU,EBAR)
      IF (ISTOP.NE. 0) GO TO 6
    3 IF(TPRINT.GT.T+.1*DT) GO TO 4
      CALL OUTPUT(1)
      TPRINT = TPRINT+DTPRNT
      CALL PLOTTP(2)
    4 IDRIVE = 0
      IF(TPATH.GT. T+0.1*DT) GO TO 40
C         SUBROUTINE DRIVER WILL DETERMINE PSI1 DURING FIRST INCREMENT
C         TO AVOID, INITIALIZE TPATH ABOVE AS TO+DELPTH
      IDRIVE = 1
      TPATH = TPATH + DELPTH
   40 NLDCTR = 0
      CALL PINT1(2,MODE,NEQ,T,DT,U,DU,EBAR)
      IF (ISTOP.NE. 0) GO TO 6
C          THETTL,PHITL,PSITL ARE VALUES OF THETT,PHIT,PSIT FROM PREVIOU
C            TIME INTERVAL, USED TO TEST NEW ANGLES     IN SUBROUTINE TMC
      THETTL = THETT
      PHITL  = PHIT
      PSITL  = PSIT
      IF(INDB.NE.0) CALL EGYSUM
      IF(T.GE.T1) GO TO 6
      IF(U**2+V**2+W**2.LE.UVWM2.AND.P2+Q2+R2.LE.PQRM2) GO TO 6
      IF(ABS(PHIT).GE.PIO2) GO TO 6
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      IF(INDB.NE.0.AND.PSIT.GE.PSIMAX) GO TO 6
      IF(IPATHT .NE. 0) GO TO 6
      IF(ABS(THETTP).LT.THETMX) GO TO 5
C      XINDL IS PREVIOUS VALUE OF XINDN. XINDL INITIALLY ZERO GETS BNMTX
C            XINDN.NE.0.0 FOR THETAO OR PHIO .NE.0.0, OR AFTER INDEXING
C            THAT IS  THETN OR PHIN NOW .NE. 0.0
C            USED IN MAIN PROGRAM AND IN SUBROUTINES CNSTNT,TMCNST
      THETN  = THETT
      THETTP= 0.0
      PHIN   = PHIT
      PHITP  = 0.0
      PSIN   = PSIT
      PSITP  = 0.0
      XINDL  = XINDN
      XINDN  = XINDN + 1.0
C     IND=1  INDICATOR FOR RE-INITIALIZATION IN PINT1
      IND = 1
    5 IF(INDCRS.EQ.0) GO TO 56
   50 DO 51  I=1,4
      IF(.NOT.LCB2(I)) GO TO 53
   51 CONTINUE
      ICBHIT = 2
   52 IF(ICBHIT.EQ.JCBHIT) GO TO 56
      JCBHIT = ICBHIT
      IND = 1
      DT = DTCOMP
      GO TO 56
   53 DO 54  I=1,4
      IF(LCB1(I)) GO TO 55
   54 CONTINUE
      ICBHIT = 0
      GO TO 52
   55 ICBHIT = 1
      IHIT = 1
      IF (ICBHIT.EQ.JCBHIT) GO TO 56
      JCBHIT = ICBHIT
      IND = 0
      DT = DELTC
      GO TO 2
   56 IF(INDB.EQ.0) GO TO 58
      IF(IBHIT.EQ.JBHIT) GO TO 58
      IF(IBHIT.GT.JBHIT) GO TO 57
      JBHIT = IBHIT
      IF(ICBHIT.EQ.1) GO TO 58
      DT = DTCOMP
      IND = 0
      GO TO 2
   57 JBHIT = IBHIT
      DT = DELTB
      IND = 0
      GO TO 2
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```
C                                                                   MAIN3050
   58 IF(IND.EQ.0) GO TO 3                                          MAIN3060
      IND = 0                                                       MAIN3070
      GO TO 2                                                       MAIN3080
C                                                                   MAIN3090
    6 CALL OUTPUT(1)                                                MAIN3100
      CALL PLOTTP(3)                                                MAIN3110
      IF(ISTOP .NE. 0) WRITE(6,59) ISTOP                            MAIN3120
   59 FORMAT(17H   ERROR, ISTOP = ,  I3)                            MAIN3130
C       CALL PLOTTP(3) CAUSES DISTINCTIVE RECORD ON TAPE FOR END OF RUN.MAIN3140
      GO TO 1                                                       MAIN3150
      END                                                           MAIN3160
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      SUBROUTINE AREA
C              HVOSM-RD2 VERSION
C              REVISED OCTOBER 1975   CALSPAN CORPORATION
      COMMON /DIMV/X1P,X2P,X3P,X4P,Y1P,Y2P,Y3P,Y4P,Z1P,Z2P,Z3P,Z4P,PHI1,
     1             PHI2,PHI3,PHI4,PSI1,PSI2,PSI3,PSI4,CAYW(4),CBYW(4),
     2             CGYW(4),ZPGI(4),THGI(4),PHGI(4),CPG(4),SPG(4),CTG(4),
     3             STG(4),CAGZ(4),CBGZ(4),CGGZ(4),D1(4),D2(4),D3(4),
     4             XLM1(4),XLM2(4),XLM3(4),AMTX(3,3),CMTX(3,4),XGPP(4),
     5             YGPP(4),ZGPP(4),DMATX(10,11),DELTA(4),CAR(4),CBR(4),
     6             CGR(4),FR(4),HI(4),FC(4),TI(4),AX(4),BX(4),CX(4),
     7             CTXG(4),UG(4),STXG(4),AY(4),BY(4),CY(4),CPYG(4),
     8             SPYG(4),VG(4),PSIIP(4),PHICI(4),CAC(4),CBC(4),CGC(4),
     9             FCXU(4),FCYU(4),FCZU(4),FS(4),CAXW(4),CBXW(4),CGXW(4)
      COMMON /DIMV/AS(4),BS(4),CS(4),CAS(4),CBS(4),CGS(4),BETP(4),
     1             BETBR(4),FSXU(4),FSYU(4),FSZU(4),FRXU(4),FRYU(4),
     2             FRZU(4),FXU(4),FYU(4),FZU(4),SI(4),F1FI(2),F1RI(2),
     3             F2FI(2),F2RI(2),CAH(4),CBH(4),CGH(4)
      DIMENSION XP(4),YP(4),ZP(4),PHII(4),PSII(4)
      EQUIVALENCE (XP(1),X1P),(YP(1),Y1P),(ZP(1),Z1P),(PHII(1),PHI1),
     1            (PSII(1),PSI1)
      COMMON/BARIER/FN,IBHIT,JBHIT,XCPNP(3),YCPNP(3),ZCPNP(3),XCPN(3),
     1              YCPN(3),ZCPN(3),AA1(17),BB1(17),CC1(17),RR1(17),
     2              AA2(17),BB2(17),CC2(17),RR2(17),CAB,CBB,CGB,CABT,
     3              CBBT,CGBT,RB,XBT,YBT,ZBT,XBB,YBB,ZBB,RR2P(17),
     4              YBPT,XNN(17),YNN(17),ZNN(17),XMTX(3,4),IDPT(17),IPT
     5              ,ININD,UNP(17),VNP(17),WNP(17),VMAX(4),I1,I2,I3,I4,
     6              XCPTP,YCPTP,ZCPTP,XCPBP,YCPBP,ZCPBP,YCPMP,AINTI,
     7              AINTP,SXR,SYR,SZR,SDEN,XRI,YRI,ZRI,FRICT,DELBB,VTAN,
     8              FNP,FB,URP,VRP,WRP,EPSL,XLDP,DELX,VL,NCYC,EEE,ENRGY,
     9              NSEG,YBPTP,PCAB,PCBB,PCGB,PPRB,CAB1,CBB1,CGB1,
     A              RB1,NUNLD,NLDCTR,VDEF,PVDEF,PSZR,XF,DELBBP,
     B              SWORK,SPENGY,DISS,IPLN,ILOAD
      DIMENSION INDXPT(4)
      EQUIVALENCE (INDXPT(1),I1)
      DIMENSION XTTT(4),ZTTT(4),SLOP(4)
      LOGICAL S2GS3,S2GS4,S3GS4
      XRIP = XRI
      YRIP = YRI
      ZRIP = ZRI
      AINTP = AINTI
      IF(IPT.EQ.3)GO TO 62
      XMIN = 1.0E30
    1 DO 2 J=1,4
      IJ = INDXPT(J)
      XTTT(J) = AMTX(1,1)*XNN(IJ)+AMTX(1,2)*YNN(IJ)+AMTX(1,3)*ZNN(IJ)
      ZTTT(J) = AMTX(3,1)*XNN(IJ)+AMTX(3,2)*YNN(IJ)+AMTX(3,3)*ZNN(IJ)
      IF(XTTT(J).GT.XMIN)GO TO 2
      JMN = J
      XMIN = XTTT(J)
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```
  2 CONTINUE                                                            AREA0500
    IF(JMN.EQ.1)GO TO 3                                                 AREA0510
    TMP1 = XTTT(1)                                                      AREA0520
    TMP2 = ZTTT(1)                                                      AREA0530
    XTTT(1) = XTTT(JMN)                                                 AREA0540
    ZTTT(1) = ZTTT(JMN)                                                 AREA0550
    XTTT(JMN) = TMP1                                                    AREA0560
    ZTTT(JMN) = TMP2                                                    AREA0570
    IJ = INDXPT(1)                                                      AREA0580
    INDXPT(1) = INDXPT(JMN)                                             AREA0590
    INDXPT(JMN) = IJ                                                    AREA0600
  3 DO 4 J=2,4                                                          AREA0610
    TMP1 = AMAX1(XTTT(J)-XTTT(1),1.0E-30)                               AREA0620
    TMP2 = ZTTT(J)-ZTTT(1)                                              AREA0630
    SLOP(J) = TMP2/TMP1                                                 AREA0640
  4 CONTINUE                                                            AREA0650
    S2GS3 = SLOP(2).GT.SLOP(3)                                          AREA0660
    S2GS4 = SLOP(2).GT.SLOP(4)                                          AREA0670
    S3GS4 = SLOP(3).GT.SLOP(4)                                          AREA0680
    IF(S2GS3)GO TO 5                                                    AREA0690
    IF(S2GS4)GO TO 62                                                   AREA0700
    JMN = 4                                                             AREA0710
    IF(S3GS4)GO TO 6                                                    AREA0720
    JMN = 3                                                             AREA0730
    GO TO 6                                                             AREA0740
  5 IF(.NOT.S2GS4)GO TO 62                                              AREA0750
    JMN = 3                                                             AREA0760
    IF(S3GS4)GO TO 6                                                    AREA0770
    JMN = 4                                                             AREA0780
  6 IJ = INDXPT(2)                                                      AREA0790
    INDXPT(2) = INDXPT(JMN)                                             AREA0800
    INDXPT(JMN) = IJ                                                    AREA0810
 62 TMPX = XNN(I1)-XNN(I2)                                              AREA0820
    TMPY = YNN(I1)-YNN(I2)                                              AREA0830
    TMPZ = ZNN(I1)-ZNN(I2)                                              AREA0840
  7 AIP = TMPY*CGB-TMPZ*CBB                                             AREA0850
    BIP = TMPZ*CAB-TMPX*CGB                                             AREA0860
    CIP = TMPX*CBB-TMPY*CAB                                             AREA0870
    DIP = SQRT(AIP**2+BIP**2+CIP**2)                                    AREA0880
    S3I = SQRT(TMPX**2+TMPY**2+TMPZ**2)                                 AREA0890
    S2I = 0.0                                                           AREA0900
    IF(IPT.EQ.4) S2I = ABS(AIP*(XNN(I4)-XNN(I2))+BIP*(YNN(I4)-YNN(I2))AREA0910
   1                    +CIP*(ZNN(I4)-ZNN(I2)))/DIP                     AREA0920
    S1I = ABS(AIP*(XNN(I3)-XNN(I2))+BIP*(YNN(I3)-YNN(I2))+CIP*(ZNN(I3)AREA0930
   1      -ZNN(I2)))/DIP                                                AREA0940
    AINTI = .5*S3I*(S1I+S2I)                                            AREA0950
  8 AC1 = .5*(XNN(I1)+XNN(I2))-XNN(I3)                                  AREA0960
    BC1 = .5*(YNN(I1)+YNN(I2))-YNN(I3)                                  AREA0970
    CC3 = .5*(ZNN(I1)+ZNN(I2))-ZNN(I3)                                  AREA0980
    AC2 = .5*(XNN(I1)+XNN(I3))-XNN(I2)                                  AREA0990
    BC2 = .5*(YNN(I1)+YNN(I3))-YNN(I2)                                  AREA1000
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```
      CC4 = .5*(ZNN(I1)+ZNN(I3))-ZNN(I2)
      NNNN = 1
    9 AC1P = BC1*CGB-CC3*CBB
      BC1P = CC3*CAB-AC1*CGB
      CC1P = AC1*CBB-BC1*CAB
      G1 = AC1P*XNN(I3)+BC1P*YNN(I3)+CC1P*ZNN(I3)
      AC2P = BC2*CGB-CC4*CBB
      BC2P = CC4*CAB-AC2*CGB
      CC2P = AC2*CBB-BC2*CAB
      G2 = AC2P*XNN(I2)+BC2P*YNN(I2)+CC2P*ZNN(I2)
      XMTX(1,1) = CAB
      XMTX(1,2) = CBB
      XMTX(1,3) = CGB
      XMTX(1,4) = RB
      XMTX(2,1) = AC1P
      XMTX(2,2) = BC1P
      XMTX(2,3) = CC1P
      XMTX(2,4) = G1
      XMTX(3,1) = AC2P
      XMTX(3,2) = BC2P
      XMTX(3,3) = CC2P
      XMTX(3,4) = G2
      CALL SIMSOL(XMTX,3,3)
      XQI = XMTX(1,4)
      YQI = XMTX(2,4)
      ZQI = XMTX(3,4)
   10 IF(IPT.EQ.4) GO TO (11,12),NNNN
      XRI = XQI
      YRI = YQI
      ZRI = ZQI
      GO TO 13
   11 XPI = XQI
      YPI = YQI
      ZPI = ZQI
      AC1 = .5*(XNN(I1)+XNN(I2))-XNN(I4)
      BC1 = .5*(YNN(I1)+YNN(I2))-YNN(I4)
      CC3 = .5*(ZNN(I1)+ZNN(I2))-ZNN(I4)
      AC2 = .5*(XNN(I1)+XNN(I4))-XNN(I2)
      BC2 = .5*(YNN(I1)+YNN(I4))-YNN(I2)
      CC4 = .5*(ZNN(I1)+ZNN(I4))-ZNN(I2)
      I3 = I4
      NNNN = 2
      GO TO 9
   12 TEMP = S2I/(S1I+S2I)
      XRI = XPI+TEMP*(XQI-XPI)
      YRI = YPI+TEMP*(YQI-YPI)
      ZRI = ZPI+TEMP*(ZQI-ZPI)
   13 IF(AINTP.NE.0.0)GO TO 14
      XRIP = XRI
      YRIP = YRI
      ZRIP = ZRI
```

```
14 TEMP = .5*(AINTI+AINTP)
   SDEN = SDEN+TEMP
   IF(NUNLD.NE.0)GO TO 15
   SXR = SXR+TEMP*(XRI+XRIP)*.5
   SYR = SYR+TEMP*(YRI+YRIP)*.5
   SZR = SZR+TEMP*(ZRI+ZRIP)*.5
15 RETURN
   END
```

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      SUBROUTINE BLK01(NBLK,NBCRD,NSEQ,NCARD,DUM,NERR)
C           HVOSM-RD2 VERSION
C           REVISED OCTOBER 1975   CALSPAN CORPORATION
      COMMON/HEAD/ VHED(20),CHED(20),GHED(20),SHED(20),THED(20),
     1             NPAGE(20)
      COMMON/INPT/PHIO,THETAO,PSIO,PO,QO,RO,XCOP,YCOP,ZCOP,UO,VO,WO,
     1            A,B,DEL10,DEL20,DEL30,PHIRO,DEL10D,DEL20D,DEL30D,
     2            PHIROD,TF,TR,ZF,ZR,RHO,AKRS,XMUR,
     3            XMS,XMUF,XIX,XIY,XIZ,XIXZ,CF,AKF,XLAMF,OMEGF,CFP,EPSF,
     4            RF,CR,AKR,XLAMR,OMEGR,CRP,EPSR,RR,TS,THMAX,DTCOMP,TO,
     5            T1,DTCMP1,DTPRNT,MODE,EBAR,EM,AAA,HMAX,HMIN,BET,G,
     6            HED(36),DADE(3),XIR,X1,Y1,Z1,X2,Y2,Z2,PHIC(50),DELB,
     7            DELE,DDEL,NDEL,PSIF(50),TQF(50),TQR(50),TB,TE,TINCR,
     8            NZTAB,NZ5,XBDRY(4,5),PSBDRY(4,5),YBDRY(2,5),NBX(5),
     9            NBY(5),NTBL1,NTBL2,NTBL3,ZGP(21,21,5)
      COMMON/INPT/XB(5),XE(5),XINCR(5),NX(5),YB(5),YE(5),YINCR(5),NY(5),
     1         XXZGP5(21),YYZGP5(21),AMUG(5),PSBDRO(4,5),UVWMIN,PQRMIN
      COMMON/INPT1/YC1P,YC2P,ZC2P,DELTC,PHIC1,PHIC2,AMUC,XIPS,
     1             CPSP,OMGPS,AKPS,EPSPS,XPS,RWHJB,RWHJE,DRWHJ,INDCRB,
     2             PSIFIO,PSIFDO
      DIMENSION YCIP(2)
      EQUIVALENCE (YCIP(1),YC1P)
      COMMON /INPT2/ YBPO,ZBTP,ZBBP,XVF,XVR,YV,ZVT,ZVB,AKV,SIGR(11),
     1               SET,CONS,AMUB,EPSV,EPSB,XM,EPST,DDD,INDB,DELYBP,
     2               DELTB,XINPT(100)
      COMMON /INSUS/ XIF,RHOF,TSF,PHIFO,PHIFOD,DEL40,DEL40D,ISUS,
     1               AKDS,AKDS1,AKDS2,AKDS3,PHIRC(50),DTHF(50),DTHR(50),
     2               NCAMF,NCAMR,NDTHF,NDTHR
      COMMON/NEWCRB/ YC3P,YC4P,YC5P,YC6P,YCLP,
     1               ZC3P,ZC4P,ZC5P,ZC6P,ZCLP,
     2               PHIC3,PHIC4,PHIC5,PHIC6,NCRBSL,
     3               TANPC3,TANPC4,TANPC5,TANPC6,TANPCL,
     4               PHIC3R,PHIC4R,PHIC5R,PHIC6R,PHICLR,
     5               YCMP(6),ZCMP(6),PHICM(6)
      DIMENSION DUM(18)
      DATA NBS/4/
      NBT = NBCRD+1
      IF(NBT.LT.1.OR.NBT.GT.NBS+1) GO TO 98
      GO TO(100,101,102,103,104),NBT
      GO TO 98
  100 IF(NCARD.NE.100) GO TO 98
      DO 10 I=1,18
   10 HED(I) = DUM(I)
      GO TO 99
  101 IF(NCARD.NE.101) GO TO 98
      TO     = DUM(1)
      T1     = DUM(2)
      DTCOMP = DUM(3)
      DTPRNT = DUM(4)
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      THMAX  = DUM(5)
      UVWMIN = DUM(6)
      PQRMIN = DUM(7)
      GO TO 99
  102 IF(NCARD.NE.102) GO TO 98
      ISUS = IFIX(DUM(1))
      INDCRB = IFIX(DUM(2))
      NCRBSL = IFIX(DUM(3))
      DELTC = DUM(4)
      INDB = IFIX(DUM(5))
      DELTB = DUM(6)
      IF(INDCRB.NE.0) NPAGE(5) = 1
      IF(INDB.EQ.0) GO TO 99
      NPAGE(17) = 1
      NPAGE(18) = 1
      NPAGE(19) = 1
      GO TO 99
  103 IF(NCARD.NE.103) GO TO 98
      MODE = DUM(1)
      EBAR = DUM(2)
      EM   = DUM(3)
      AAA  = DUM(4)
      HMAX = DUM(5)
      HMIN = DUM(6)
      BET  = DUM(7)
      GO TO 99
  104 IF(NCARD.NE.104) GO TO 98
      NPAGE(4) = DUM(1)
      NPAGE(6) = DUM(2)
      NPAGE(7) = DUM(3)
      NPAGE(8) = DUM(4)
      NPAGE(9) = DUM(5)
      NPAGE(10)= DUM(6)
      NPAGE(14)= DUM(7)
      GO TO 99
   98 NERR = 1
   99 RETURN
      END
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      SUBROUTINE BLK02(NBLK,NBCRD,NSEQ,NCARD,DUM,NERR)                  BLK20010
C              HVOSM-RD2 VERSION                                        BLK20020
C              REVISED OCTOBER 1975   CALSPAN CORPORATION               BLK20030
      COMMON/HEAD/ VHED(20),CHED(20),GHED(20),SHED(20),THED(20),        BLK20040
     1             NPAGE(20)                                            BLK20050
      COMMON/INPT/PHIO,THETAO,PSIO,PO,QO,RO,XCOP,YCOP,ZCOP,UO,VO,WO,    BLK20060
     1            A,B,DEL10,DEL20,DEL30,PHIRO,DEL10D,DEL20D,DEL30D,     BLK20070
     2            PHIROD,TF,TR,ZF,ZR,RHO,AKRS,XMUR,                     BLK20080
     3            XMS,XMUF,XIX,XIY,XIZ,XIXZ,CF,AKF,XLAMF,OMEGF,CFP,EPSF,BLK20090
     4            RF,CR,AKR,XLAMR,OMEGR,CRP,EPSR,RR,TS,THMAX,DTCOMP,TO, BLK20100
     5            T1,DTCMP1,DTPRNT,MODE,EBAR,EM,AAA,HMAX,HMIN,BET,G,    BLK20110
     6            HED(36),DADE(3),XIR,X1,Y1,Z1,X2,Y2,Z2,PHIC(50),DELB,  BLK20120
     7            DELE,DDEL,NDEL,PSIF(50),TQF(50),TQR(50),TB,TE,TINCR,  BLK20130
     8            NZTAB,NZ5,XBDRY(4,5),PSBDRY(4,5),YBDRY(2,5),NBX(5),   BLK20140
     9            NBY(5),NTBL1,NTBL2,NTBL3,ZGP(21,21,5)                 BLK20150
      COMMON/INPT/XB(5),XE(5),XINCR(5),NX(5),YB(5),YE(5),YINCR(5),NY(5),BLK20160
     1          XXZGP5(21),YYZGP5(21),AMUG(5),PSBDRO(4,5),UVWMIN,PQRMIN BLK20170
      COMMON/INPT1/YC1P,YC2P,ZC2P,DELTC,PHIC1,PHIC2,AMUC,XIPS,          BLK20180
     1             CPSP,OMGPS,AKPS,EPSPS,XPS,RWHJB,RWHJE,DRWHJ,INDCRB,  BLK20190
     2             PSIFIO,PSIFDO                                        BLK20200
      DIMENSION YC1P(2)                                                 BLK20210
      EQUIVALENCE (YC1P(1),YC1P)                                        BLK20220
      COMMON /INPT2/ YBPO,ZBTP,ZBBP,XVF,XVR,YV,ZVT,ZVB,AKV,SIGR(11),    BLK20230
     1               SET,CONS,AMUB,EPSV,EPSB,XM,EPST,DDD,INDB,DELYBP,   BLK20240
     2               DELTB,XINPT(100)                                   BLK20250
      COMMON/INPT3/ AKFC,AKFCP,OMEGFC,AKFE,AKFEP,OMEGFE,AKRC,AKRCP,     BLK20260
     1              OMEGRC,AKRE,AKREP,OMEGRE,END3                       BLK20270
      COMMON/APTABL/ APFR(21,2),IAPFR(2),DAPFB,DAPFE,DDAPF,NAPF,        BLK20280
     1               DAPRB,DAPRE,DDAPR,NAPR                             BLK20290
      DIMENSION APF(21),APR(21)                                         BLK20300
      EQUIVALENCE (APFR(1,1),APF(1)),(APFR(1,2),APR(1))                 BLK20310
      COMMON /INSUS/ XIF,RHOF,TSF,PHIFO,PHIFOD,DEL40,DEL40D,ISUS,       BLK20320
     1               AKDS,AKDS1,AKDS2,AKDS3,PHIRC(50),DTHF(50),DTHR(50),BLK20330
     2               NCAMF,NCAMR,NDTHF,NDTHR                            BLK20340
      COMMON/BARSTR/XSTIO(3),YSTIO(3),ZSTIO(3),XSTI(3),YSTI(3),         BLK20350
     1              ZSTI(3),YSTIPO(3),XSTIP(3),YSTIP(3),ZSTIP(3),       BLK20360
     2              FNSTI(3),AKST(3)                                    BLK20370
      DIMENSION DUM(18)                                                 BLK20380
      DATA NBS/14/                                                      BLK20390
      NBT=NBCRD+1                                                       BLK20400
      IF(NBT.LT.1.OR.NBT.GT.NBS+1) GO TO 98                             BLK20410
      GO TO(200,201,202,203,204,205,206,207,208,209,210,211,            BLK20420
     1      212,213,214),NBT                                            BLK20430
      GO TO 98                                                          BLK20440
  200 IF(NCARD.NE.200) GO TO 98                                         BLK20450
      DO 10 I=1,18                                                      BLK20460
   10 VHED(I) = DUM(I)                                                  BLK20470
      GO TO 99                                                          BLK20480
  201 IF(NCARD.NE.201) GO TO 98                                         BLK20490
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      XMS  = DUM(1)                                                    BLK20500
      XMUF = DUM(2)                                                    BLK20510
      XMUR = DUM(3)                                                    BLK20520
      XIX  = DUM(4)                                                    BLK20530
      XIY  = DUM(5)                                                    BLK20540
      XIZ  = DUM(6)                                                    BLK20550
      XIXZ = DUM(7)                                                    BLK20560
      XIR  = DUM(8)                                                    BLK20570
      XIF = DUM(9)                                                     BLK20580
      GO TO 99                                                         BLK20590
  202 IF(NCARD.NE.202) GO TO 98                                        BLK20600
      A    = DUM(1)                                                    BLK20610
      B    = DUM(2)                                                    BLK20620
      TF   = DUM(3)                                                    BLK20630
      TR   = DUM(4)                                                    BLK20640
      RHO = DUM(5)                                                     BLK20650
      TS = DUM(6)                                                      BLK20660
      RHOF = DUM(7)                                                    BLK20670
      TSF = DUM(8)                                                     BLK20680
      G = 386.4                                                        BLK20690
      IF(DUM(9).NE.0.0) G = DUM(9)                                     BLK20700
      GO TO 99                                                         BLK20710
  203 IF(NCARD.NE.203) GO TO 98                                        BLK20720
      X1 = DUM(1)                                                      BLK20730
      Y1 = DUM(2)                                                      BLK20740
      Z1 = DUM(3)                                                      BLK20750
      X2 = DUM(4)                                                      BLK20760
      Y2 = DUM(5)                                                      BLK20770
      Z2 = DUM(6)                                                      BLK20780
      DO 30 J=1,6                                                      BLK20790
      IF(DUM(J).NE.0.0) NPAGE(16) = 1                                  BLK20800
   30 CONTINUE                                                         BLK20810
      ZF = DUM(7)                                                      BLK20820
      ZR = DUM(8)                                                      BLK20830
      GO TO 99                                                         BLK20840
  204 IF(NCARD.NE.204) GO TO 98                                        BLK20850
      AKF    = DUM(1)                                                  BLK20860
      AKFC   = DUM(2)                                                  BLK20870
      AKFCP  = DUM(3)                                                  BLK20880
      AKFE   = DUM(4)                                                  BLK20890
      AKFEP  = DUM(5)                                                  BLK20900
      XLAMF  = DUM(6)                                                  BLK20910
      OMEGFC = DUM(7)                                                  BLK20920
      OMEGFE = DUM(8)                                                  BLK20930
      GO TO 99                                                         BLK20940
  205 IF(NCARD.NE.205)GO TO 98                                         BLK20950
      AKR    = DUM(1)                                                  BLK20960
      AKRC   = DUM(2)                                                  BLK20970
      AKRCP  = DUM(3)                                                  BLK20980
      AKRE   = DUM(4)                                                  BLK20990
      AKREP  = DUM(5)                                                  BLK21000
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      XLAMR  = DUM(6)
      OMEGRC = DUM(7)
      OMEGRE = DUM(8)
      GO TO 99
  206 IF(NCARD.NE.206) GO TO 98
      CF   = DUM(1)
      CFP  = DUM(2)
      EPSF = DUM(3)
      CR   = DUM(4)
      CRP  = DUM(5)
      EPSR = DUM(6)
      GO TO 99
  207 IF(NCARD.NE.207) GO TO 98
      RF = DUM(1)
      RR = DUM(2)
      AKRS = DUM(3)
      AKDS = DUM(4)
      AKDS1 = DUM(5)
      AKDS2 = DUM(6)
      AKDS3 = DUM(7)
      GO TO 99
  208 IF(NCARD.NE.208) GO TO 98
      XIPS  = DUM(1)
      CPSP  = DUM(2)
      OMGPS = DUM(3)
      AKPS  = DUM(4)
      EPSPS = DUM(5)
      XPS   = DUM(6)
      GO TO 99
  209 IF(NCARD.NE.209.OR.NSEQ.NE.0) GO TO 98
      DELB = DUM(1)
      DELE = DUM(2)
      DDEL = DUM(3)
      NDTHF = DUM(4)
      NDTHR = DUM(5)
      NDEL = (DELE-DELB)/DDEL +1
      NCRDS = (NDEL-1)/9 + 1
      CALL TREAD(NCARD,NCRDS,NDEL,50,PHIC,NERR)
      IF(NERR.NE.0) GO TO 98
      IF(ISUS.EQ.1) CALL TREAD(NCARD,NCRDS,NDEL,50,PHIRC,NERR)
      IF(NERR.NE.0) GO TO 98
      IF(NDTHF.NE.0) CALL TREAD(NCARD,NCRDS,NDEL,50,DTHF,NERR)
      IF(NERR.NE.0) GO TO 98
      IF(NDTHR.NE.0) CALL TREAD(NCARD,NCRDS,NDEL,50,DTHR,NERR)
      IF(NERR.NE.0) GO TO 98
      GO TO 99
  210 IF(NCARD.NE.210.OR.NSEQ.NE.0) GO TO 98
      DAPFB = DUM(1)
      DAPFE = DUM(2)
      DDAPF = DUM(3)
      NAPF = (DAPFE-DAPFB)/DDAPF + 1
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      NCRDS = (NAPF-1)/9 + 1                                            BLK21520
      CALL TREAD(NCARD,NCRDS,NAPF,21,APF,NERR)                          BLK21530
      IAPFR(1) = 1                                                      BLK21540
      IF(NERR.NE.0) GO TO 98                                            BLK21550
      GO TO 99                                                          BLK21560
  211 IF(NCARD.NE.211.OR.NSEQ.NE.0) GO TO 98                            BLK21570
      DAPRB = DUM(1)                                                    BLK21580
      DAPRE = DUM(2)                                                    BLK21590
      DDAPR = DUM(2)                                                    BLK21600
      NAPR = (DAPRE-DAPRB)/DDAPR + 1                                    BLK21610
      NCRDS = (NAPF-1)/9 + 1                                            BLK21620
      CALL TREAD(NCARD,NCRDS,NAPR,21,APR,NERR)                          BLK21630
      IAPFR(2) = 1                                                      BLK21640
      IF(NERR.NE.0)GO TO 98                                             BLK21650
      GO TO 99                                                          BLK21660
  212 IF(NCARD.NE.212) GO TO 98                                         BLK21670
      XVF = DUM(1)                                                      BLK21680
      XVR = DUM(2)                                                      BLK21690
      YV  = DUM(3)                                                      BLK21700
      ZVT = DUM(4)                                                      BLK21710
      ZVB = DUM(5)                                                      BLK21720
      AKV = DUM(6)                                                      BLK21730
      GO TO 99                                                          BLK21740
  213 IF(NCARD.NE.213) GO TO 98                                         BLK21750
      XSTIO(1) = DUM(1)                                                 BLK21760
      XSTIO(2) = DUM(2)                                                 BLK21770
      XSTIO(3) = DUM(3)                                                 BLK21780
      YSTIO(1) = DUM(4)                                                 BLK21790
      YSTIO(2) = DUM(5)                                                 BLK21800
      YSTIO(3) = DUM(6)                                                 BLK21810
      GO TO 99                                                          BLK21820
  214 IF(NCARD.NE.214) GO TO 98                                         BLK21830
      ZSTIO(1) = DUM(1)                                                 BLK21840
      ZSTIO(2) = DUM(2)                                                 BLK21850
      ZSTIO(3) = DUM(3)                                                 BLK21860
      AKST(1) = DUM(4)                                                  BLK21870
      AKST(2) = DUM(5)                                                  BLK21880
      AKST(3) = DUM(6)                                                  BLK21890
      GO TO 99                                                          BLK21900
   98 NERR =  1                                                         BLK21910
   99 RETURN                                                            BLK21920
      END                                                               BLK21930
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      SUBROUTINE BLK03(NBLK,NBCRD,NSEQ,NCARD,DUM,NERR)                   BLK30010
C              HVOSM-RD2 VERSION                                         BLK30020
C              REVISED OCTOBER 1975   CALSPAN CORPORATION                BLK30030
      COMMON/HEAD/ VHED(20),CHED(20),GHED(20),SHED(20),THED(20),         BLK30040
     1            NPAGE(20)                                              BLK30050
      COMMON/INPT1/YC1P,YC2P,ZC2P,DELTC,PHIC1,PHIC2,AMUC,XIPS,           BLK30060
     1            CPSP,OMGPS,AKPS,EPSPS,XPS,RWHJB,RWHJE,DRWHJ,INDCRB,    BLK30070
     2            PSIFIO,PSIFDO                                          BLK30080
      DIMENSION YCIP(2)                                                  BLK30090
      EQUIVALENCE (YCIP(1),YC1P)                                         BLK30100
      COMMON /TIRIN/ AKT(4),SIGT(4),XLAMT(4),A0(4),A1(4),A2(4),A3(4),    BLK30110
     1              A4(4),OMEGT(4),AMU(4),RW(4),FJP(35,4),A234(4),       BLK30120
     2              A12(4),OMT2A2(4),OMT2M1(4),A23(4),ITIR(4)            BLK30130
      DIMENSION DUM(18),TDUM(9,4)                                        BLK30140
      DATA NBS/2/                                                        BLK30150
      NBT = NBCRD+1                                                      BLK30160
      IF(NBT.LT.1.OR.NBT.GT.NBS+1) GO TO 98                              BLK30170
      GO TO(300,301,302),NBT                                             BLK30180
      GO TO 98                                                           BLK30190
  300 IF(NCARD.NE.300) GO TO 98                                          BLK30200
      DO 10 I=1,18                                                       BLK30210
   10 THED(I) = DUM(I)                                                   BLK30220
      GO TO 99                                                           BLK30230
  301 IF(NCARD.NE.301.OR.NSEQ.NE.0) GO TO 98                             BLK30240
      ITIR(1) = DUM(1)                                                   BLK30250
      ITIR(2) = DUM(2)                                                   BLK30260
      ITIR(3) = DUM(3)                                                   BLK30270
      ITIR(4) = DUM(4)                                                   BLK30280
      RWHJE = DUM(5)                                                     BLK30290
      DRWHJ = DUM(6)                                                     BLK30300
      N = MAX0(ITIR(1),ITIR(2),ITIR(3),ITIR(4))                          BLK30310
      CALL T2READ(NCARD,9,9,N,TDUM,NERR)                                 BLK30320
      IF(NERR.NE.0) GO TO 98                                             BLK30330
      DO 20 I=1,4                                                        BLK30340
      J = ITIR(I)                                                        BLK30350
      AKT(I) = TDUM(1,J)                                                 BLK30360
      SIGT(I) = TDUM(2,J)                                                BLK30370
      XLAMT(I) = TDUM(3,J)                                               BLK30380
      A0(I) = TDUM(4,J)                                                  BLK30390
      A1(I) = TDUM(5,J)                                                  BLK30400
      A2(I) = TDUM(6,J)                                                  BLK30410
      A3(I) = TDUM(7,J)                                                  BLK30420
      A4(I) = TDUM(8,J)                                                  BLK30430
      OMEGT(I) = TDUM(9,J)                                               BLK30440
   20 CONTINUE                                                           BLK30450
      GO TO 99                                                           BLK30460
  302 IF(NCARD.NE.302) GO TO 98                                          BLK30470
      DO 30 I=1,4                                                        BLK30480
      J = ITIR(I)                                                        BLK30490
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      AMU(I) = DUM(J)                                                   BLK30500
      RW(I) = DUM(J+4)                                                  BLK30510
   30 CONTINUE                                                          BLK30520
      GO TO 99                                                          BLK30530
   98 NERR = 1.0                                                        BLK30540
   99 RETURN                                                            BLK30550
      END                                                               BLK30560
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```
      SUBROUTINE BLK04(NBLK,NBCRD,NSEQ,NCARD,DUM,NERR)
C           HVOSM-RD2 VERSION
C           REVISED OCTOBER 1975   CALSPAN CORPORATION
      COMMON/HEAD/ VHED(20),CHED(20),GHED(20),SHED(20),THED(20),
     1            NPAGE(20)
      COMMON/INPT/PHIO,THETAO,PSIO,PO,QO,RO,XCOP,YCOP,ZCOP,UO,VO,WO,
     1           A,B,DEL1O,DEL2O,DEL3O,PHIRO,DEL1OD,DEL2OD,DEL3OD,
     2           PHIROD,TF,TR,ZF,ZR,RHO,AKRS,XMUR,
     3           XMS,XMUF,XIX,XIY,XIZ,XIXZ,CF,AKF,XLAMF,OMEGF,CFP,EPSF,
     4           RF,CR,AKR,XLAMR,OMEGR,CRP,EPSR,RR,TS,THMAX,DTCOMP,TO,
     5           T1,DTCMP1,DTPRNT,MODE,EBAR,EM,AAA,HMAX,HMIN,BET,G,
     6           HED(36),DADE(3),XIR,X1,Y1,Z1,X2,Y2,Z2,PHIC(50),DELB,
     7           DELE,DDEL,NDEL,PSIF(50),TQF(50),TQR(50),TB,TE,TINCR,
     8           NZTAB,NZ5,XBDRY(4,5),PSBDRY(4,5),YBDRY(2,5),NBX(5),
     9           NBY(5),NTBL1,NTBL2,NTBL3,ZGP(21,21,5)
      COMMON/INPT/XB(5),XE(5),XINCR(5),NX(5),YB(5),YE(5),YINCR(5),NY(5),
     1         XXZGP5(21),YYZGP5(21),AMUG(5),PSBDRO(4,5),UVWMIN,PQRMIN
      DIMENSION DUM(18)
      DATA NBS/1/
      NBT = NBCRD+1
      IF(NBT.LT.1.OR.NBT.GT.NBS+1) GO TO 98
      GO TO(400,401),NBT
      GO TO 98
  400 IF(NCARD.NE.400) GO TO 98
      DO 10 I=1,18
   10 CHED(I) = DUM(I)
      GO TO 99
  401 IF(NCARD.NE.401.OR.NSEQ.NE.0) GO TO 98
      TB    = DUM(1)
      TE    = DUM(2)
      TINCR = DUM(3)
      NTBL1 = IFIX(DUM(4))
      NTBL2 = IFIX(DUM(5))
      NTBL3 = IFIX(DUM(6))
      IF(NTBL2.NE.0.OR.NTBL3.NE.0) NPAGE(13) = 1
      IF(NTBL1+NTBL2+NTBL3.EQ.0) GO TO 99
      NT = IFIX((TE-TB)/TINCR + 1.2)
      NCRDS = (NT-1)/9 + 1
      IF(NTBL1.EQ.0) GO TO 11
      CALL TREAD(NCARD,NCRDS,NT,50,PSIF,NERR)
      IF(NERR.NE.0) GO TO 98
   11 IF(NTBL2.EQ.0) GO TO 12
      CALL TREAD(NCARD,NCRDS,NT,50,TQF,NERR)
      IF(NERR.NE.0) GO TO 98
   12 IF(NTBL3.EQ.0) GO TO 99
      CALL TREAD(NCARD,NCRDS,NT,50,TQR,NERR)
      IF(NERR.EQ.0) GO TO 99
   98 NERR = 1
   99 RETURN
```

END

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      SUBROUTINE BLK05(NBLK,NBCRD,NSEQ,NCARD,DUM,NERR)
C               HVOSM-RD2 VERSION
C               REVISED OCTOBER 1975   CALSPAN CORPORATION
      COMMON/HEAD/ VHED(20),CHED(20),GHED(20),SHED(20),THED(20),
     1              NPAGE(20)
      COMMON/INPT/PHIO,THETAO,PSIO,PO,QO,RO,XCOP,YCOP,ZCOP,UO,VO,WO,
     1             A,B,DEL10,DEL20,DEL30,PHIRO,DEL10D,DEL20D,DEL30D,
     2             PHIROD,TF,TR,ZF,ZR,RHO,AKRS,XMUR,
     3             XMS,XMUF,XIX,XIY,XIZ,XIXZ,CF,AKF,XLAMF,OMEGF,CFP,EPSF,
     4             RF,CR,AKR,XLAMR,OMEGR,CRP,EPSR,RR,TS,THMAX,DTCOMP,TO,
     5             T1,DTCMP1,DTPRNT,MODE,EBAR,EM,AAA,HMAX,HMIN,BET,G,
     6             HED(36),DADE(3),XIR,X1,Y1,Z1,X2,Y2,Z2,PHIC(50),DELB,
     7             DELE,DDEL,NDEL,PSIF(50),TQF(50),TQR(50),TB,TE,TINCR,
     8             NZTAB,NZ5,XBDRY(4,5),PSBDRY(4,5),YBDRY(2,5),NBX(5),
     9             NBY(5),NTBL1,NTBL2,NTBL3,ZGP(21,21,5)
      COMMON/INPT/XB(5),XE(5),XINCR(5),NX(5),YB(5),YE(5),YINCR(5),NY(5),
     1           XXZGP5(21),YYZGP5(21),AMUG(5),PSBDRO(4,5),UVWMIN,PQRMIN
      COMMON/INPT1/YC1P,YC2P,ZC2P,DELTC,PHIC1,PHIC2,AMUC,XIPS,
     1              CPSP,OMGPS,AKPS,EPSPS,XPS,RWHJB,RWHJE,DRWHJ,INDCRB,
     2              PSIFIO,PSIFDO
      DIMENSION YCIP(2)
      EQUIVALENCE (YCIP(1),YC1P)
      COMMON /INPT2/ YBPO,ZBTP,ZBBP,XVF,XVR,YV,ZVT,ZVB,AKV,SIGR(11),
     1               SET,CONS,AMUB,EPSV,EPSB,XM,EPST,DDD,INDB,DELYBP,
     2               DELTB,XINPT(100)
      COMMON/NEWCRB/ YC3P,YC4P,YC5P,YC6P,YCLP,
     1               ZC3P,ZC4P,ZC5P,ZC6P,ZCLP,
     2               PHIC3,PHIC4,PHIC5,PHIC6,NCRBSL,
     3               TANPC3,TANPC4,TANPC5,TANPC6,TANPCL,
     4               PHIC3R,PHIC4R,PHIC5R,PHIC6R,PHICLR,
     5               YCMP(6),ZCMP(6),PHICM(6)
      COMMON /RUFNES/ DELG,DGMAX,NEND,IRUF
      DIMENSION DUM(18)
      DATA NBS/13/
      NBT = NBCRD+1
      IF(NBT.LT.1.OR.NBT.GT.NBS+1) GO TO 98
      GO TO (500,501,502,503,504,505,506,507,508,509,510,
     1    511,512,513),NBT
      GO TO 98
  500 IF(NCARD.NE.500) GO TO 98
      DO 10 I=1,18
   10 GHED(I) = DUM(I)
      GO TO 99
  501 IF(NCARD.NE.501) GO TO 98
      IF(NZTAB.LT.1) NZTAB=1
      I = 1
      GO TO 20
  502 IF(NCARD.NE.502) GO TO 98
      IF(NZTAB.LT.2) NZTAB = 2
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      I = 2
      GO TO 20
  503 IF(NCARD.NE.503) GO TO 98
      IF(NZTAB.LT.3) NZTAB = 3
      I = 3
      GO TO 20
  504 IF(NCARD.NE.504) GO TO 98
      IF(NZTAB.LT.4) NZTAB = 4
      I = 4
      GO TO 20
  505 IF(NCARD.NE.505) GO TO 98
      NZTAB = 5
      I = 5
   20 NPAGE(15) = 1
      XB(I)    = DUM(1)
      XE(I)    = DUM(2)
      XINCR(I) = DUM(3)
      YB(I)    = DUM(4)
      YE(I)    = DUM(5)
      YINCR(I) = DUM(6)
      NBX(I) = IFIX(DUM(7))
      NBY(I) = IFIX(DUM(8))
      NZ5T = IFIX(DUM(9))
      NNBX = NBX(I)
      NNBY = NBY(I)
      IF(NZ5T.EQ.1) GO TO 21
      NNX = IFIX((XE(I)-XB(I))/XINCR(I) + 1.2)
      NNY = IFIX((YE(I)-YB(I))/YINCR(I) + 1.2)
      NX(I) = NNX
      NY(I) = NNY
      CALL TEREAD(I,NNBX,NNBY,NNX,NNY,NZ5T,NERR)
      IF(NERR.NE.0) GO TO 98
      GO TO 99
   21 NNX = IFIX(DUM(3))
      NNY = IFIX(DUM(6))
      NX(I) = NNX
      NY(I) = NNY
      NZ5 = 1
      CALL TEREAD(I,NNBX,NNBY,NNX,NNY,NZ5T,NERR)
      IF(NERR.NE.0) GO TO 98
      GO TO 99
  506 IF(NCARD.NE.506) GO TO 98
      DO 30 J=1,5
   30 AMUG(J) = DUM(J)
      GO TO 99
  507 IF(NCARD.NE.507) GO TO 98
      YC1P = DUM(1)
      YC2P = DUM(2)
      YC3P = DUM(3)
      YC4P = DUM(4)
      YC5P = DUM(5)
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      YC6P = DUM(6)                                                     BLK51010
      AMUC = DUM(7)                                                     BLK51020
      GO TO 99                                                          BLK51030
  508 IF(NCARD.NE.508) GO TO 98                                         BLK51040
      ZC2P = DUM(1)                                                     BLK51050
      ZC3P = DUM(2)                                                     BLK51060
      ZC4P = DUM(3)                                                     BLK51070
      ZC5P = DUM(4)                                                     BLK51080
      ZC6P = DUM(5)                                                     BLK51090
      GO TO 99                                                          BLK51100
  509 IF(NCARD.NE.509) GO TO 98                                         BLK51110
      PHIC1 = DUM(1)                                                    BLK51120
      PHIC2 = DUM(2)                                                    BLK51130
      PHIC3 = DUM(3)                                                    BLK51140
      PHIC4 = DUM(4)                                                    BLK51150
      PHIC5 = DUM(5)                                                    BLK51160
      PHIC6 = DUM(6)                                                    BLK51170
      GO TO 99                                                          BLK51180
  510 IF(NCARD.NE.510) GO TO 98                                         BLK51190
      YBPO = DUM(1)                                                     BLK51200
      ZBTP = DUM(2)                                                     BLK51210
      ZBBP = DUM(3)                                                     BLK51220
      DELYBP = DUM(4)                                                   BLK51230
      AMUB = DUM(5)                                                     BLK51240
      EPSV = DUM(6)                                                     BLK51250
      EPSB = DUM(7)                                                     BLK51260
      SET = DUM(8)                                                      BLK51270
      CONS = DUM(9)                                                     BLK51280
      GO TO 99                                                          BLK51290
  511 IF(NCARD.NE.511) GO TO 98                                         BLK51300
      DO 40 I=1,9                                                       BLK51310
   40 SIGR(I) = DUM(I)                                                  BLK51320
      GO TO 99                                                          BLK51330
  512 IF(NCARD.NE.512) GO TO 98                                         BLK51340
      SIGR(10) = DUM(1)                                                 BLK51350
      SIGR(11) = DUM(2)                                                 BLK51360
      GO TO 99                                                          BLK51370
  513 IF(NCARD.NE.513) GO TO 98                                         BLK51380
      DELG = DUM(1)                                                     BLK51390
      NEND = IFIX(DUM(2))                                               BLK51400
      IRUF = 1                                                          BLK51410
      NPAGE(8) = 1                                                      BLK51420
      DGMAX = (NEND-1)*DELG                                             BLK51430
      GO TO 99                                                          BLK51440
   98 NERR = 1                                                          BLK51450
   99 RETURN                                                            BLK51460
      END                                                               BLK51470
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      SUBROUTINE BLK06(NBLK,NBCRD,NSEQ,NCARD,DUM,NERR)                  BLK60010
C             HVOSM-RD2 VERSION                                         BLK60020
C             REVISED OCTOBER 1975   CALSPAN CORPORATION                BLK60030
      COMMON/HEAD/ VHED(20),CHED(20),GHED(20),SHED(20),THED(20),        BLK60040
     1             NPAGE(20)                                            BLK60050
      COMMON/INPT/PHIO,THETAO,PSIO,PO,QO,RO,XCOP,YCOP,ZCOP,UO,VO,WO,    BLK60060
     1            A,B,DEL10,DEL20,DEL30,PHIRO,DEL10D,DEL20D,DEL30D,     BLK60070
     2            PHIROD,TF,TR,ZF,ZR,RHO,AKRS,XMUR,                     BLK60080
     3            XMS,XMUF,XIX,XIY,XIZ,XIXZ,CF,AKF,XLAMF,OMEGF,CFP,EPSF,BLK60090
     4            RF,CR,AKR,XLAMR,OMEGR,CRP,EPSR,RR,TS,THMAX,DTCOMP,TO, BLK60100
     5            T1,DTCMP1,DTPRNT,MODE,EBAR,EM,AAA,HMAX,HMIN,BET,G,    BLK60110
     6            HED(36),DADE(3),XIR,X1,Y1,Z1,X2,Y2,Z2,PHIC(50),DELB,  BLK60120
     7            DELE,DDEL,NDEL,PSIF(50),TQF(50),TQR(50),TB,TE,TINCR,  BLK60130
     8            NZTAB,NZ5,XBDRY(4,5),PSBDRY(4,5),YBDRY(2,5),NBX(5),   BLK60140
     9            NBY(5),NTBL1,NTBL2,NTBL3,ZGP(21,21,5)                 BLK60150
      COMMON/INPT/XB(5),XE(5),XINCR(5),NX(5),YB(5),YE(5),YINCR(5),NY(5),BLK60160
     1          XXZGP5(21),YYZGP5(21),AMUG(5),PSBDRO(4,5),UVWMIN,PQRMIN BLK60170
      COMMON/INPT1/YC1P,YC2P,ZC2P,DELTC,PHIC1,PHIC2,AMUC,XIPS,          BLK60180
     1             CPSP,OMGPS,AKPS,EPSPS,XPS,RWHJB,RWHJE,DRWHJ,INDCRB,  BLK60190
     2             PSIFIO,PSIFDO                                        BLK60200
      COMMON /INSUS/ XIF,RHOF,TSF,PHIFO,PHIFOD,DEL40,DEL40D,ISUS,       BLK60210
     1               AKDS,AKDS1,AKDS2,AKDS3,PHIRC(50),DTHF(50),DTHR(50),BLK60220
     2               NCAMF,NCAMR,NDTHF,NDTHR                            BLK60230
      DIMENSION YCIP(2)                                                 BLK60240
      EQUIVALENCE (YCIP(1),YC1P)                                        BLK60250
      DIMENSION DUM(18)                                                 BLK60260
      DATA NBS/3/                                                       BLK60270
      NBT = NBCRD+1                                                     BLK60280
      IF(NBT.LT.1.OR.NBT.GT.NBS+1) GO TO 98                             BLK60290
      GO TO (600,601,602,603),NBT                                       BLK60300
      GO TO 98                                                          BLK60310
  600 IF(NCARD.NE.600) GO TO 98                                         BLK60320
      DO 10 I=1,18                                                      BLK60330
   10 SHED(I) = DUM(I)                                                  BLK60340
      GO TO 99                                                          BLK60350
  601 IF(NCARD.NE.601) GO TO 98                                         BLK60360
      PHIO   = DUM(1)                                                   BLK60370
      THETAO = DUM(2)                                                   BLK60380
      PSIO   = DUM(3)                                                   BLK60390
      PO     = DUM(4)                                                   BLK60400
      QO     = DUM(5)                                                   BLK60410
      RO = DUM(6)                                                       BLK60420
      PSIFIO = DUM(7)                                                   BLK60430
      PSIFDO = DUM(8)                                                   BLK60440
      GO TO 99                                                          BLK60450
  602 IF(NCARD.NE.602) GO TO 98                                         BLK60460
      XCOP = DUM(1)                                                     BLK60470
      YCOP = DUM(2)                                                     BLK60480
      ZCOP = DUM(3)                                                     BLK60490
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      U0    = DUM(4)                                                    BLK60500
      V0    = DUM(5)                                                    BLK60510
      W0    = DUM(6)                                                    BLK60520
      GO TO 99                                                          BLK60530
  603 IF(NCARD.NE.603) GO TO 98                                         BLK60540
      DEL10  = DUM(1)                                                   BLK60550
      DEL20 = DUM(2)                                                    BLK60560
      IF(ISUS.EQ.2) PHIF0 = DUM(2)                                      BLK60570
      DEL30  = DUM(3)                                                   BLK60580
      PHIR0 = DUM(4)                                                    BLK60590
      IF(ISUS.EQ.1) DEL40 = DUM(4)                                      BLK60600
      DEL10D = DUM(5)                                                   BLK60610
      DEL20D = DUM(6)                                                   BLK60620
      IF(ISUS.EQ.2) PHIF0D = DUM(6)                                     BLK60630
      DEL30D = DUM(7)                                                   BLK60640
      PHIR0D = DUM(8)                                                   BLK60650
      IF(ISUS.EQ.1) DEL40D = DUM(8)                                     BLK60660
      GO TO 99                                                          BLK60670
   98 NERR = 1                                                          BLK60680
   99 RETURN                                                            BLK60690
      END                                                               BLK60700
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      SUBROUTINE CLEAR(A,B)
C          CLEARS (SETS TO ZERO) A BLOCK OF STORAGE IDENTIFIED BY THE
C           ADDRESSES OF THE TWO ARGUMENTS.
C
C          CALL CLEAR(P,Q)
C          WILL CAUSE ALL BYTES TO BE SET TO ZERO FROM ADDRESS
C          P THROUGH THE FULL-WORD AT ADDRESS Q
C
      DIMENSION A(1),B(1)
      B(1) = 1.0
      I = 0
   10 IF(B(1).EQ.0.0) RETURN
      I=I+1
      A(I) = 0.0
      END
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      SUBROUTINE CNSTNT                                                 CNST0010
C           HVOSM-RD2 VERSION     .                                     CNST0020
C           REVISED OCTOBER 1975  CALSPAN CORPORATION                   CNST0030
      COMMON/HEAD/ VHED(20),CHED(20),GHED(20),SHED(20),THED(20),        CNST0040
     1           NPAGE(20)                                              CNST0050
      COMMON/INPT/PHIO,THETAO,PSIO,PO,QO,RO,XCOP,YCOP,ZCOP,UO,VO,WO,    CNST0060
     1          A,B,DEL10,DEL20,DEL30,PHIRO,DEL10D,DEL20D,DEL30D,       CNST0070
     2          PHIROD,TF,TR,ZF,ZR,RHO,AKRS,XMUR,                       CNST0080
     3          XMS,XMUF,XIX,XIY,XIZ,XIXZ,CF,AKF,XLAMF,OMEGF,CFP,EPSF,CNST0090
     4          RF,CR,AKR,XLAMR,OMEGR,CRP,EPSR,RR,TS,THMAX,DTCOMP,TO,   CNST0100
     5          T1,DTCMP1,DTPRNT,MODE,EBAR,EM,AAA,HMAX,HMIN,BET,G,      CNST0110
     6          HED(36),DADE(3),XIR,X1,Y1,Z1,X2,Y2,Z2,PHIC(50),DELB,    CNST0120
     7          DELE,DDEL,NDEL,PSIF(50),TQF(50),TQR(50),TB,TE,TINCR,    CNST0130
     8          NZTAB,NZ5,XBDRY(4,5),PSBDRY(4,5),YBDRY(2,5),NBX(5),     CNST0140
     9          NBY(5),NTBL1,NTBL2,NTBL3,ZGP(21,21,5)                   CNST0150
      COMMON/INPT/XB(5),XE(5),XINCR(5),NX(5),YB(5),YE(5),YINCR(5),NY(5),CNST0160
     1        XXZGP5(21),YYZGP5(21),AMUG(5),PSBDRO(4,5),UVWMIN,PQRMIN CNST0170
      COMMON/INPT1/YC1P,YC2P,ZC2P,DELTC,PHIC1,PHIC2,AMUC,XIPS,          CNST0180
     1           CPSP,OMGPS,AKPS,EPSPS,XPS,RWHJB,RWHJE,DRWHJ,INDCRB,    CNST0190
     2           PSIFIO,PSIFDO                                          CNST0200
      DIMENSION YCIP(2)                                                 CNST0210
      EQUIVALENCE (YCIP(1),YC1P)                                        CNST0220
      COMMON /INTG/NEQ,T,DT,VAR(50),DER(50)                             CNST0230
      EQUIVALENCE (U,VAR(1)),(V,VAR(2)),(W,VAR(3)),(P,VAR(4)),(Q,VAR(5))CNST0240
     1          ,(R,VAR(6)),(DEL1,VAR(7)),(DEL1D,VAR(8)),(DEL2,VAR(9)),CNST0250
     2           (DEL2D,VAR(10)),(DEL3,VAR(11)),(DEL3D,VAR(12)),        CNST0260
     3           (PHIR,VAR(13)),(PHIRD,VAR(14)),(THETTP,VAR(15)),       CNST0270
     4           (PHITP,VAR(16)),(PSITP,VAR(17)),(XCP,VAR(18)),         CNST0280
     5           (YCP,VAR(19)),(ZCP,VAR(20)),(PSIFI,VAR(21)),           CNST0290
     6           (PSIFID,VAR(22))                                       CNST0300
      EQUIVALENCE (DU,DER(1)),(DV,DER(2)),(DW,DER(3)),(DP,DER(4)),      CNST0310
     1           (DQ,DER(5)),(DR,DER(6)),(DDEL1,DER(7)),(DDEL1D,DER(8))CNST0320
     2          ,(DDEL2,DER(9)),(DDEL2D,DER(10)),(DDEL3,DER(11)),       CNST0330
     3           (DDEL3D,DER(12)),(DPHIR,DER(13)),(DPHIRD,DER(14)),     CNST0340
     4           (DTHTTP,DER(15)),(DPHITP,DER(16)),(DPSITP,DER(17)),    CNST0350
     5           (DXCP,DER(18)),(DYCP,DER(19)),(DZCP,DER(20)),          CNST0360
     6           (DPSIFI,DER(21)),(DDPSFI,DER(22))                      CNST0370
      EQUIVALENCE (VAR(9),PHIF),(VAR(10),PHIFD),(DER(9),DPHIF),         CNST0380
     1           (DER(10),DPHIFD)                                       CNST0390
      EQUIVALENCE (VAR(13),DEL4),(VAR(14),DEL4D),(DER(13),DDEL4),       CNST0400
     1           (DER(14),DDEL4D)                                       CNST0410
      COMMON /COMP/SUMM,THETN,PHIN,PSIN,PI,RAD,GAM1,GAM2,GAM3,GAM4,GAM5,CNST0420
     1          GAM6,GAM7,GAM8,GAM9,THETT,PHIT,PSIT,ZRO,TRO2,           CNST0430
     2           TFO2,TIZ,RHO2,RHOMUR,AMUF,BMUR,ZPR,TM4,RHMR2,AO2APB,   CNST0440
     3           BO2APB,RFTF,TSO2,RRTS,BROMUR,XMUFO2,AXMFO2,XMTFO4,     CNST0450
     4           XIZR,RTR,RHMR2I,XIXP,XIZP,XIXZP,XIYZP,D1PD2,D1MD2,     CNST0460
     5           ZRD3,ZRD3R,ZFD3R,ZFD12,TIZ2,TG61,DD1P2,DD1M2,RPR,PHRPCNST0470
     6          ,TANTP,SPHTP,CPHTP,SECTP,SFXS,SFYS,SFZS,SNPS,SNTS,      CNST0480
     7           SNPSS,TPR,CAY,CBY,CGY,CAX,CBX,CGX,SFYU,SFXU,SFYUF,     CNST0490
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     8          SFYUR,SFZU,COSTH,SINTH,COSPS,SINPS,COSPH,SINPH,ANG1,  CNST0500
     9          ANG2,CPHI,SPHI,CPSI,SPSI,P1,P7,P3,P4,P5,P6,TX,TY,TZ   CNST0510
      COMMON /COMP/TRH,DISTX,DISTY,DISTD,DISTS,D21,ZETA4,ZETA4D,ZETA3,  CNST0520
     1          ZETA3D,SFZ1,SNPU,SNTU,HCGH1,HCGH2,HCGH3,HCGH4,TERM1,  CNST0530
     2          TERM2,SNPSU,SNPR,HCBH1,HCBH2,HCBH3,HCBH4,HCAH1,HCAH2,CNST0540
     3          HCAH3,HCAH4,UQ,WP,UR,QR,VP,PR,P2,Q2,R2,VR,WQ,PQ,PHIR2CNST0550
     4         ,PHIRD2,RPHRD,GCTH,GSTH,GCTSP,GCTCP,XXX,YYY,IX,IY,XX1,CNST0560
     5          XX2,YY1,YY2,THG1,THG2,PHG1,PHG2,ZZ1,ZZ2,LLL           CNST0570
      DIMENSION HCAH(4),HCBH(4),HCGH(4)                                 CNST0580
      EQUIVALENCE (HCAH(1),HCAH1),(HCBH(1),HCBH1),(HCGH(1),HCGH1)       CNST0590
      COMMON /COMPN/ FRSP(4),FRCP(4),ICBHIT,JCBHIT,                     CNST0600
     1              DPSINT,TANPC1,TANPC2,PHIC1R,PHIC2R,AMUCMP,PHI1D,    CNST0610
     2              PHI2D,LCB1(4),LCB2(4),IHIT,AJMTX(3,3),BMTX(3,3),    CNST0620
     3              SFRX(4),SFRY(4),SFRZ(4),T1PSI,T2PSI,XMUGI(4)        CNST0630
      LOGICAL LCB1,LCB2                                                 CNST0640
C      COMMON/EINDEX/ FOR EULER ANGLE INDEXING,MAIN,CNSTNT,DAUX,TMCNST  CNST0650
      COMMON/EINDEX/ TWOPI,PIO2,PIO4,XINDN,XINDL,THETTL,PHITL,PSITL,    CNST0660
     1              COSTHN,SINTHN,COSPSN,SINPSN,COSPHN,SINPHN,CTHETP,   CNST0670
     2              STHETP,CPSTP,SPSTP,BNMTX(3,3), CNMTX(3,3),ENDEIN    CNST0680
      COMMON /INPT2/ YBPO,ZBTP,ZBBP,XVF,XVR,YV,ZVT,ZVB,AKV,SIGR(11),    CNST0690
     1              SET,CONS,AMUB,EPSV,EPSB,XM,EPST,DDD,INDB,DELYBP,    CNST0700
     2              DELTB,XINPT(100)                                    CNST0710
      COMMON /TIRIN/ AKT(4),SIGT(4),XLAMT(4),A0(4),A1(4),A2(4),A3(4),   CNST0720
     1              A4(4),OMEGT(4),AMU(4),RW(4),FJP(35,4),A234(4),      CNST0730
     2              A12(4),OMT2A2(4),OMT2M1(4),A23(4),ITIR(4)           CNST0740
      COMMON/BARIER/FN,IBHIT,JBHIT,XCPNP(3),YCPNP(3),ZCPNP(3),XCPN(3),  CNST0750
     1            YCPN(3),ZCPN(3),AA1(17),BB1(17),CC1(17),RR1(17),      CNST0760
     2            AA2(17),BB2(17),CC2(17),RR2(17),CAB,CBB,CGB,CABT,     CNST0770
     3            CBBT,CGBT,RB,XBT,YBT,ZBT,XBB,YBB,ZBB,RR2P(17),        CNST0780
     4            YBPT,XNN(17),YNN(17),ZNN(17),XMTX(3,4),IDPT(17),IPT   CNST0790
     5            ,ININD,UNP(17),VNP(17),WNP(17),VMAX(4),I1,I2,I3,I4,   CNST0800
     6            XCPTP,YCPTP,ZCPTP,XCPBP,YCPBP,ZCPBP,YCPMP,AINTI,      CNST0810
     7            AINTP,SXR,SYR,SZR,SDEN,XRI,YRI,ZRI,FRICT,DELBB,VTAN,CNST0820
     8            FNP,FB,URP,VRP,WRP,EPSL,XLDP,DELX,VL,NCYC,EEE,ENRGY,CNST0830
     9            NSEG,YBPTP,PCAB,PCBB,PCGB,PPRB,CAB1,CBB1,CGB1,        CNST0840
     A            RB1,NUNLD,NLDCTR,VDEF,PVDEF,PSZR,XF,DELBBP,           CNST0850
     B            SWORK,SPENGY,DISS,IPLN,ILOAD                          CNST0860
      DIMENSION INDXPT(4)                                               CNST0870
      EQUIVALENCE (INDXPT(1),I1)                                        CNST0880
      COMMON /INSUS/ XIF,RHOF,TSF,PHIFO,PHIFOD,DEL40,DEL40D,ISUS,       CNST0890
     1              AKDS,AKDS1,AKDS2,AKDS3,PHIRC(50),DTHF(50),DTHR(50),CNST0900
     2              NCAMF,NCAMR,NDTHF,NDTHR                             CNST0910
      COMMON /SUSCMP/ XMURO2,BXMRO2,XMTRO4,ZFO,TSFO2,RHOF2,RHFMUF,      CNST0920
     1               RHF2MF,RF2MFI,RTF,RRTR,D3PD4,D3MD4,D43,DD3P4,      CNST0930
     2               DD3M4,ZFD1RF,ZRD34,RFPF,RPF2M,WFMF,PHFP,PHIF2,     CNST0940
     3               PHIFD2,RPHFD,ZFD1,ZFD2,ZRD4,TPF,SLOPE3,SLOPE4,     CNST0950
     4               PHI3D,PHI4D,DTHF1,DTHF2,DTHR3,DTHR4,DTDD1,         CNST0960
     5               DTDD2,DTDD3,DTDD4,FJF(4),SNPF                      CNST0970
      COMMON/NEWCRB/ YC3P,YC4P,YC5P,YC6P,YCLP,                          CNST0980
     1              ZC3P,ZC4P,ZC5P,ZC6P,ZCLP,                           CNST0990
     2              PHIC3,PHIC4,PHIC5,PHIC6,NCRBSL,                     CNST1000
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     3                 TANPC3,TANPC4,TANPC5,TANPC6,TANPCL,
     4                 PHIC3R,PHIC4R,PHIC5R,PHIC6R,PHICLR,
     5                 YCMP(6),ZCMP(6),PHICM(6)
      NPAGE(1) = 1
      NPAGE(2) = 1
      NPAGE(3) = 1
      NPAGE(11) = 1
      NPAGE(12) = 1
C  OTHER OUTPUT PAGE INDICATORS EITHER READ OR SET IN BLKXX SUBROUTINES
      PI = 3.141592653D0
      TWOPI =  2.0*PI
      PIO2  =  0.5 * PI
      PIO4  =  0.25* PI
      RAD =  .0174532925D0
      DO 7 I=1,4
      A12(I) = A1(I)/A2(I)
      A23(I) = A2(I)*A3(I)/A1(I)
      A234(I) = A2(I)*A3(I)/A4(I)
      OMT2M1(I) = OMEGT(I)*A1(I)*A2(I)*(OMEGT(I)-1.0)
      OMT2A2(I) = (OMEGT(I)*A2(I)*A3(I)*(A4(I)-OMEGT(I)*A2(I)))
     1            /(A4(I)*(OMT2M1(I)-A0(I)))
    7 CONTINUE
      TRO2 = 0.5*TR
      TFO2 = 0.5*TF
      AMUF  = A*XMUF
      BMUR  = B*XMUR
      XMUFO2 = 0.5*XMUF
      AXMFO2 = A*XMUFO2
      XMTFO4 = XMUFO2*TFO2
      TM4 = 0.25*XMUF*TF
      GMSTMP = 0.5*XMS*G/(A+B)
      AO2APB = A*GMSTMP
      BO2APB = B*GMSTMP
      GAM1 = AMUF-BMUR
      SUMM = XMS+XMUF+XMUR
      DEL1 = DEL10
      DEL1D = DEL10D
      DEL3 = DEL30
      DEL3D = DEL30D
      IF(ISUS.EQ.1) GO TO 10
      ZRO = ZR+RHO
      TSO2 = 0.5*TS
      RHO2 = RHO*RHO
      RHOMUR = RHO*XMUR
      RHMR2 = RHO*RHOMUR
      RTR = RR/TS
      BROMUR = RHOMUR*B
      RHMR2I = RHMR2+XIR
      PHIR = PHIR0
      PHIRD = PHIR0D
   10 IF(ISUS.NE.0) GO TO 20
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      ZPR = ZF+RHO                                                      CNST1520
      RRTS = RR*TS                                                      CNST1530
      TIZ = XMUF*(A*A+TFO2*TFO2)+BMUR                                   CNST1540
      XIZR = XIZ+XIR                                                    CNST1550
   20 IF(ISUS.EQ.2) GO TO 30                                            CNST1560
      RFTF = RF/(TF*TF)                                                 CNST1570
      DEL2 = DEL20                                                      CNST1580
      DEL2D = DEL20D                                                    CNST1590
   30 IF(ISUS.NE.2) GO TO 40                                            CNST1600
      ZFO = ZF+RHOF                                                     CNST1610
      TSFO2 = 0.5*TSF                                                   CNST1620
      RHOF2 = RHOF*RHOF                                                 CNST1630
      RHFMUF = RHOF*XMUF                                                CNST1640
      RHF2MF = RHOF*RHFMUF                                              CNST1650
      RF2MFI = RHF2MF+XIF                                               CNST1660
      RTF = RF/TSF                                                      CNST1670
      PHIF = PHIFO                                                      CNST1680
      PHIFD = PHIFOD                                                    CNST1690
   40 IF(ISUS.NE.1) GO TO 50                                            CNST1700
      RRTR = RR/(TR*TR)                                                 CNST1710
      XMURO2 = 0.5*XMUR                                                 CNST1720
      BXMRO2 = B*XMURO2                                                 CNST1730
      XMTRO4 = XMURO2*TRO2                                              CNST1740
      DEL4 = DEL40                                                      CNST1750
      DEL4D = DEL40D                                                    CNST1760
   50 CONTINUE                                                          CNST1770
      U = UO                                                            CNST1780
      V = VO                                                            CNST1790
      W = WO                                                            CNST1800
      P = PO*RAD                                                        CNST1810
      Q = QO*RAD                                                        CNST1820
      R = RO*RAD                                                        CNST1830
      THETTP = 0.0                                                      CNST1840
      PHITP = 0.0                                                       CNST1850
      PSITP = 0.0                                                       CNST1860
      THETN = THETAO*RAD                                                CNST1870
      PHIN = PHIO*RAD                                                   CNST1880
      PSIN = PSIO*RAD                                                   CNST1890
C      XINDL IS PREVIOUS VALUE OF XINDN. XINDL INITIALLY ZERO GETS BNMTXCNST1900
C            XINDN.NE.0.0 FOR THETAO OR PHIO .NE.0.0, OR AFTER INDEXING CNST1910
C            THAT IS  THETN OR PHIN NOW .NE. 0.0                        CNST1920
C            USED IN MAIN PROGRAM AND IN SUBROUTINES CNSTNT,TMCNST      CNST1930
      IF( THETN.NE.0.0 .OR.  PHIN.NE. 0.0) XINDN = 10.0                 CNST1940
      THETTL = THETN                                                    CNST1950
      PHITL  = PHIN                                                     CNST1960
      PSITL  = PSIN                                                     CNST1970
      XCP = XCOP                                                        CNST1980
      YCP = YCOP                                                        CNST1990
      ZCP = ZCOP                                                        CNST2000
      PHIC1R = PHIC1*RAD                                                CNST2010
      PHIC2R = PHIC2*RAD                                                CNST2020
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      PHIC3R = PHIC3*RAD                                                CNST2030
      PHIC4R = PHIC4*RAD                                                CNST2040
      PHIC5R = PHIC5*RAD                                                CNST2050
      PHIC6R = PHIC6*RAD                                                CNST2060
      TANPC2 = TAN(PHIC2R)                                              CNST2070
      TANPC1 = TAN(PHIC1R)                                              CNST2080
      TANPC3 = TAN(PHIC3R)                                              CNST2090
      TANPC4 = TAN(PHIC4R)                                              CNST2100
      TANPC5 = TAN(PHIC5R)                                              CNST2110
      TANPC6 = TAN(PHIC6R)                                              CNST2120
      NCB = NCRBSL-1                                                    CNST2130
      GO TO (72,73,74,75,76),NCB                                        CNST2140
   72 PHICLR = PHIC2R                                                   CNST2150
      YCLP = YC2P                                                       CNST2160
      ZCLP = ZC2P                                                       CNST2170
      TANPCL = TANPC2                                                   CNST2180
      YC3P = 1.0E+6                                                     CNST2190
      ZC3P = ZC2P+SIGN(1.0,ZC2P)                                        CNST2200
      GO TO 71                                                          CNST2210
   73 PHICLR = PHIC3R                                                   CNST2220
      YCLP = YC3P                                                       CNST2230
      ZCLP = ZC3P                                                       CNST2240
      TANPCL = TANPC3                                                   CNST2250
      YC4P = 1.0E+6                                                     CNST2260
      ZC4P = ZC3P+SIGN(1.0,ZC3P)                                        CNST2270
      GO TO 71                                                          CNST2280
   74 PHICLR = PHIC4R                                                   CNST2290
      YCLP = YC4P                                                       CNST2300
      ZCLP = ZC4P                                                       CNST2310
      TANPCL = TANPC4                                                   CNST2320
      YC5P = 1.0E+6                                                     CNST2330
      ZC5P = ZC4P+SIGN(1.0,ZC4P)                                        CNST2340
      GO TO 71                                                          CNST2350
   75 PHICLR = PHIC5R                                                   CNST2360
      YCLP = YC5P                                                       CNST2370
      ZCLP = ZC5P                                                       CNST2380
      TANPCL = TANPC5                                                   CNST2390
      YC6P = 1.0E+6                                                     CNST2400
      ZC6P = ZC5P+SIGN(1.0,ZC5P)                                        CNST2410
      GO TO 71                                                          CNST2420
   76 PHICLR = PHIC6R                                                   CNST2430
      YCLP = YC6P                                                       CNST2440
      ZCLP = ZC6P                                                       CNST2450
      TANPCL = TANPC6                                                   CNST2460
   71 CONTINUE                                                          CNST2470
      PSIFI  = PSIFIO*RAD                                               CNST2480
      PSIFID = PSIFDO                                                   CNST2490
      DO 9 I=1,5                                                        CNST2500
      DO 9 J=1,4                                                        CNST2510
    9 PSBDRY(J,I) = PSBDRO(J,I) * RAD                                   CNST2520
      XCPN(1) = XVF                                                     CNST2530
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      YCPN(1) = YV                                              CNST2540
      ZCPN(1) = 0.0                                             CNST2550
      XCPN(2) = XVR                                             CNST2560
      YCPN(2) = YV                                              CNST2570
      ZCPN(2) = 0.0                                             CNST2580
      XCPN(3) = XVF                                             CNST2590
      YCPN(3) = -YV                                             CNST2600
      ZCPN(3) = 0.0                                             CNST2610
      AA1(1) = 1.0                                              CNST2620
      AA1(2) = 1.0                                              CNST2630
      AA1(3) = 1.0                                              CNST2640
      AA1(7) = 1.0                                              CNST2650
      AA1(8) = 1.0                                              CNST2660
      AA1(9) = 1.0                                              CNST2670
      AA1(14) = 1.0                                             CNST2680
      AA1(15) = 1.0                                             CNST2690
      BB1(4) = 1.0                                              CNST2700
      BB1(5) = 1.0                                              CNST2710
      BB1(6) = 1.0                                              CNST2720
      BB1(10) = 1.0                                             CNST2730
      BB1(11) = 1.0                                             CNST2740
      BB1(16) = 1.0                                             CNST2750
      BB1(17) = 1.0                                             CNST2760
      CC1(12) = 1.0                                             CNST2770
      CC1(13) = 1.0                                             CNST2780
      CC2(1) = 1.0                                              CNST2790
      CC2(2) = 1.0                                              CNST2800
      RR1(1) = XVF                                              CNST2810
      RR1(2) = XVF                                              CNST2820
      RR1(3) = XVF                                              CNST2830
      RR1(4) = YV                                               CNST2840
      RR1(5) = YV                                               CNST2850
      RR1(6) = YV                                               CNST2860
      RR1(7) = XVR                                              CNST2870
      RR1(8) = XVR                                              CNST2880
      RR1(9) = XVF                                              CNST2890
      RR1(10) = -YV                                             CNST2900
      RR1(11) = -YV                                             CNST2910
      RR1(12) = ZVT                                             CNST2920
      RR1(13) = ZVB                                             CNST2930
      RR1(14) = XVF                                             CNST2940
      RR1(15) = XVR                                             CNST2950
      RR1(16) = YV                                              CNST2960
      RR1(17) = -YV                                             CNST2970
      AA2(6) = 1.0                                              CNST2980
      BB2(3) = 1.0                                              CNST2990
      BB2(9) = 1.0                                              CNST3000
      CC2(4) = 1.0                                              CNST3010
      CC2(5) = 1.0                                              CNST3020
      CC2(7) = 1.0                                              CNST3030
      CC2(8) = 1.0                                              CNST3040
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      CC2(10) = 1.0                                                     CNST3050
      CC2(11) = 1.0                                                     CNST3060
      RR2(1) = ZVT                                                      CNST3070
      RR2(2) = ZVB                                                      CNST3080
      RR2(3) = YV                                                       CNST3090
      RR2(4) = ZVT                                                      CNST3100
      RR2(5) = ZVB                                                      CNST3110
      RR2(6) = XVR                                                      CNST3120
      RR2(7) = ZVT                                                      CNST3130
      RR2(8) = ZVB                                                      CNST3140
      RR2(9) = -YV                                                      CNST3150
      RR2(10) = ZVT                                                     CNST3160
      RR2(11) = ZVB                                                     CNST3170
      YBPT = YBPO                                                       CNST3180
      YBPTP = YBPO                                                      CNST3190
      RETURN                                                            CNST3200
      END                                                               CNST3210
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      SUBROUTINE CRBIMP(I)
C              HVOSM-RD2 VERSION
C              REVISED OCTOBER 1975   CALSPAN CORPORATION
      COMMON/INPT1/YC1P,YC2P,ZC2P,DELTC,PHIC1,PHIC2,AMUC,XIPS,
     1         CPSP,OMGPS,AKPS,EPSPS,XPS,RWHJB,RWHJE,DRWHJ,INDCRB,
     2         PSIFIO,PSIFDO
      DIMENSION YCIP(2)
      EQUIVALENCE (YCIP(1),YC1P)
      COMMON /INTG/NEQ,T,DT,VAR(50),DER(50)
      EQUIVALENCE (U,VAR(1)),(V,VAR(2)),(W,VAR(3)),(P,VAR(4)),(Q,VAR(5))
     1        ,(R,VAR(6)),(DEL1,VAR(7)),(DEL1D,VAR(8)),(DEL2,VAR(9)),
     2         (DEL2D,VAR(10)),(DEL3,VAR(11)),(DEL3D,VAR(12)),
     3         (PHIR,VAR(13)),(PHIRD,VAR(14)),(THETTP,VAR(15)),
     4         (PHITP,VAR(16)),(PSITP,VAR(17)),(XCP,VAR(18)),
     5         (YCP,VAR(19)),(ZCP,VAR(20)),(PSIF1,VAR(21)),
     6         (PSIFID,VAR(22))
      EQUIVALENCE (DU,DER(1)),(DV,DER(2)),(DW,DER(3)),(DP,DER(4)),
     1         (DQ,DER(5)),(DR,DER(6)),(DDEL1,DER(7)),(DDEL1D,DER(8))
     2        ,(DDEL2,DER(9)),(DDEL2D,DER(10)),(DDEL3,DER(11)),
     3         (DDEL3D,DER(12)),(DPHIR,DER(13)),(DPHIRD,DER(14)),
     4         (DTHTTP,DER(15)),(DPHITP,DER(16)),(DPSITP,DER(17)),
     5         (DXCP,DER(18)),(DYCP,DER(19)),(DZCP,DER(20)),
     6         (DPSIFI,DER(21)),(DDPSFI,DER(22))
      EQUIVALENCE (VAR(9),PHIF),(VAR(10),PHIFD),(DER(9),DPHIF),
     1         (DER(10),DPHIFD)
      EQUIVALENCE (VAR(13),DEL4),(VAR(14),DEL4D),(DER(13),DDEL4),
     1         (DER(14),DDEL4D)
      COMMON /DIMV/X1P,X2P,X3P,X4P,Y1P,Y2P,Y3P,Y4P,Z1P,Z2P,Z3P,Z4P,PHI1,
     1         PHI2,PHI3,PHI4,PSI1,PSI2,PSI3,PSI4,CAYW(4),CBYW(4),
     2         CGYW(4),ZPGI(4),THGI(4),PHGI(4),CPG(4),SPG(4),CTG(4),
     3         STG(4),CAGZ(4),CBGZ(4),CGGZ(4),D1(4),D2(4),D3(4),
     4         XLM1(4),XLM2(4),XLM3(4),AMTX(3,3),CMTX(3,4),XGPP(4),
     5         YGPP(4),ZGPP(4),DMATX(10,11),DELTA(4),CAR(4),CBR(4),
     6         CGR(4),FR(4),HI(4),FC(4),TI(4),AX(4),BX(4),CX(4),
     7         CTXG(4),UG(4),STXG(4),AY(4),BY(4),CY(4),CPYG(4),
     8         SPYG(4),VG(4),PSIIP(4),PHICI(4),CAC(4),CBC(4),CGC(4),
     9         FCXU(4),FCYU(4),FCZU(4),FS(4),CAXW(4),CBXW(4),CGXW(4)
      COMMON /DIMV/AS(4),BS(4),CS(4),CAS(4),CBS(4),CGS(4),BETP(4),
     1         BETBR(4),FSXU(4),FSYU(4),FSZU(4),FRXU(4),FRYU(4),
     2         FRZU(4),FXU(4),FYU(4),FZU(4),SI(4),F1FI(2),F1RI(2),
     3         F2FI(2),F2RI(2),CAH(4),CBH(4),CGH(4)
      DIMENSION XP(4),YP(4),ZP(4),PHII(4),PSII(4)
      EQUIVALENCE (XP(1),X1P),(YP(1),Y1P),(ZP(1),Z1P),(PHII(1),PHI1),
     1         (PSII(1),PSI1)
      COMMON /COMP/SUMM,THETN,PHIN,PSIN,PI,RAD,GAM1,GAM2,GAM3,GAM4,GAM5,
     1        GAM6,GAM7,GAM8,GAM9,THETT,PHIT,PSIT,ZRO,TRO2,
     2         TFO2,TIZ,RHO2,RHOMUR,AMUF,BMUR,ZPR,TM4,RHMR2,AO2APB,
     3         BO2APB,RFTF,TSO2,RRTS,BROMUR,XMUFO2,AXMFO2,XMTFO4,
     4         XIZR,RTR,RHMR2I,XIXP,XIZP,XIXZP,XIYZP,D1PD2,D1MD2,
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     5            ZRD3,ZRD3R,ZFD3R,ZFD12,TIZ2,TG61,DD1P2,DD1M2,RPR,PHRPCRBI0500
     6           ,TANTP,SPHTP,CPHTP,SECTP,SFXS,SFYS,SFZS,SNPS,SNTS,     CRBI0510
     7            SNPSS,TPR,CAY,CBY,CGY,CAX,CBX,CGX,SFYU,SFXU,SFYUF,    CRBI0520
     8            SFYUR,SFZU,COSTH,SINTH,COSPS,SINPS,COSPH,SINPH,ANG1,  CRBI0530
     9            ANG2,CPHI,SPHI,CPSI,SPSI,P1,P7,P3,P4,P5,P6,TX,TY,TZ   CRBI0540
      COMMON /COMP/TRH,DISTX,DISTY,DISTD,DISTS,D21,ZETA4,ZETA4D,ZETA3,  CRBI0550
     1            ZETA3D,SFZ1,SNPU,SNTU,HCGH1,HCGH2,HCGH3,HCGH4,TERM1,  CRBI0560
     2            TERM2,SNPSU,SNPR,HCBH1,HCBH2,HCBH3,HCBH4,HCAH1,HCAH2,CRBI0570
     3            HCAH3,HCAH4,UQ,WP,UR,QR,VP,PR,P2,Q2,R2,VR,WQ,PQ,PHIR2CRBI0580
     4           ,PHIRD2,RPHRD,GCTH,GSTH,GCTSP,GCTCP,XXX,YYY,IX,IY,XX1,CRBI0590
     5            XX2,YY1,YY2,THG1,THG2,PHG1,PHG2,ZZ1,ZZ2,LLL           CRBI0600
      DIMENSION HCAH(4),HCBH(4),HCGH(4)                                 CRBI0610
      EQUIVALENCE (HCAH(1),HCAH1),(HCBH(1),HCBH1),(HCGH(1),HCGH1)       CRBI0620
      COMMON /COMPN/ FRSP(4),FRCP(4),ICBHIT,JCBHIT,                     CRBI0630
     1               DPSINT,TANPC1,TANPC2,PHIC1R,PHIC2R,AMUCMP,PHI1D,   CRBI0640
     2               PHI2D,LCB1(4),LCB2(4),IHIT,AJMTX(3,3),BMTX(3,3),   CRBI0650
     3               SFRX(4),SFRY(4),SFRZ(4),T1PSI,T2PSI,XMUGI(4)       CRBI0660
      LOGICAL LCB1,LCB2                                                 CRBI0670
      COMMON /TIRIN/ AKT(4),SIGT(4),XLAMT(4),A0(4),A1(4),A2(4),A3(4),   CRBI0680
     1               A4(4),OMEGT(4),AMU(4),RW(4),FJP(35,4),A234(4),     CRBI0690
     2               A12(4),OMT2A2(4),OMT2M1(4),A23(4),ITIR(4)          CRBI0700
      COMMON/NEWCRB/ YC3P,YC4P,YC5P,YC6P,YCLP,                          CRBI0710
     1               ZC3P,ZC4P,ZC5P,ZC6P,ZCLP,                          CRBI0720
     2               PHIC3,PHIC4,PHIC5,PHIC6,NCRBSL,                    CRBI0730
     3               TANPC3,TANPC4,TANPC5,TANPC6,TANPCL,                CRBI0740
     4               PHIC3R,PHIC4R,PHIC5R,PHIC6R,PHICLR,                CRBI0750
     5               YCMP(6),ZCMP(6),PHICM(6)                           CRBI0760
      DIMENSION FJPP(35)                                                CRBI0770
      DO 20 N=1,35                                                      CRBI0780
   20 FJPP(N) = FJP(N,I)                                                CRBI0790
    1 SNPSI = SIN(PSII(I))                                              CRBI0800
      CSPSI = COS(PSII(I))                                              CRBI0810
      SNPHI = SIN(PHII(I))                                              CRBI0820
      CSPHI = COS(PHII(I))                                              CRBI0830
      SFRX(I) = 0.0                                                     CRBI0840
      SFRY(I) = 0.0                                                     CRBI0850
      SFRZ(I) = 0.0                                                     CRBI0860
      TTAJ21 = CSPHI * SNPSI                                            CRBI0870
      TTAJ31 = SNPHI * SNPSI                                            CRBI0880
      AJMTX(1,2) = -SNPSI                                               CRBI0890
      AJMTX(2,2) = CSPHI * CSPSI                                        CRBI0900
      AJMTX(3,2) = SNPHI * CSPSI                                        CRBI0910
      XJ = -26.0*RAD                                                    CRBI0920
    2 DO 11  J=1,53                                                     CRBI0930
      THTJ = 4.0*XJ                                                     CRBI0940
      STJ = SIN(THTJ)                                                   CRBI0950
      CTJ = COS(THTJ)                                                   CRBI0960
      AJMTX(1,1) = CTJ*CSPSI                                            CRBI0970
      AJMTX(2,1) = TTAJ21*CTJ + SNPHI*STJ                               CRBI0980
      AJMTX(3,1) = TTAJ31*CTJ - CSPHI*STJ                               CRBI0990
      AJMTX(1,3) = CSPHI*STJ                                            CRBI1000
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      AJMTX(2,3) = TTAJ21*STJ - SNPHI*CTJ
      AJMTX(3,3) = TTAJ31*STJ + CSPHI*CTJ
C        AJMTX ANGLE SEQUENCE IS PHI,PSI,THJ
    3 DO 8  K=1,3
    4 DO 7  L=1,3
      BMTX(K,L) = 0.0
    5 DO 6  M=1,3
      BMTX(K,L) = BMTX(K,L)+AMTX(K,M)*AJMTX(M,L)
    6 CONTINUE
    7 CONTINUE
    8 CONTINUE
      HJ = -ZP(I)/BMTX(3,3)
      IF(HJ.LT.0.0.OR.HJ.GE.RW(I)) GO TO 800
      YJP = YP(I)+BMTX(2,3)*HJ
      IF(YJP.LT.YC1P) GO TO 203
  800 HJ = (-ZP(I)+(YP(I)-YC1P)*TANPC1)/(BMTX(3,3)-BMTX(2,3)*TANPC1)
      IF(HJ.LT.0.0.OR.HJ.GE.RW(I)) GO TO 805
      YJP = YP(I)+BMTX(2,3)*HJ
      ZJP = ZP(I)+BMTX(3,3)*HJ
      IF(YJP.GE.YC1P.AND.YJP.LE.YC2P.AND.(ABS(ZJP).LE.ABS(ZC2P)).AND.
     1 (SIGN(1.0,ZJP).EQ.SIGN(1.0,ZC2P))) GO TO 204
  805 HJ = (ZC2P-ZP(I)+(YP(I)-YC2P)*TANPC2)/(BMTX(3,3)-BMTX(2,3)*
     1     TANPC2)
      IF(HJ.LT.0.0.OR.HJ.GE.RW(I)) GO TO 810
      YJP = YP(I)+BMTX(2,3)*HJ
      ZJP = ZP(I)+BMTX(3,3)*HJ
      IF(YJP.GT.YC2P.AND.YJP.LE.YC3P.AND.(ABS(ZJP).LE.ABS(ZC3P)).AND.
     1 (SIGN(1.0,ZJP).EQ.SIGN(1.0,ZC3P))) GO TO 204
  810 IF(NCRBSL.EQ.2) GO TO 10
      HJ = (ZC3P-ZP(I)+(YP(I)-YC3P)*TANPC3)/(BMTX(3,3)-BMTX(2,3)*TANPC3)
      IF(HJ.LT.0.0.OR.HJ.GE.RW(I)) GO TO 815
      YJP = YP(I)+BMTX(2,3)*HJ
      ZJP = ZP(I)+BMTX(3,3)*HJ
      IF(YJP.GT.YC3P.AND.YJP.LE.YC4P.AND.(ABS(ZJP).LE.ABS(ZC4P)).AND.
     1 (SIGN(1.0,ZJP).EQ.SIGN(1.0,ZC4P))) GO TO 204
  815 IF(NCRBSL.EQ.3) GO TO 10
      HJ= (ZC4P-ZP(I)+(YP(I)-YC4P)*TANPC4)/(BMTX(3,3)-BMTX(2,3)*TANPC4)
      IF(HJ.LT.0.0.OR.HJ.GE.RW(I)) GO TO 820
      YJP = YP(I)+BMTX(2,3)*HJ
      ZJP = ZP(I)+BMTX(3,3)*HJ
      IF(YJP.GT.YC4P.AND.YJP.LE.YC5P.AND.(ABS(ZJP).LE.ABS(ZC5P)).AND.
     1 (SIGN(1.0,ZJP).EQ.SIGN(1.0,ZC5P))) GO TO 204
  820 IF(NCRBSL.EQ.4) GO TO 10
      HJ= (ZC5P-ZP(I)+(YP(I)-YC5P)*TANPC5)/(BMTX(3,3)-BMTX(2,3)*TANPC5)
      IF(HJ.LT.0.0.OR.HJ.GE.RW(1)) GO TO 825
      YJP = YP(I)+BMTX(2,3)*HJ
      ZJP = ZP(I)+BMTX(3,3)*HJ
      IF(YJP.GT.YC5P.AND.YJP.LE.YC6P.AND.(ABS(ZJP).LE.ABS(ZC6P)).AND.
     1 (SIGN(1.0,ZJP).EQ.SIGN(1.0,ZC6P))) GO TO 204
  825 IF(NCRBSL.EQ.5) GO TO 10
      HJ= (ZC6P-ZP(I)+(YP(I)-YC6P)*TANPC6)/(BMTX(3,3)-BMTX(2,3)*TANPC6)
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      IF(HJ.LT.0.0.OR.HJ.GE.RW(I)) GO TO 10
      YJP = YP(I)+BMTX(2,3)*HJ
      IF(YJP.LT.YC6P) GO TO 10
  203 ZJP = ZP(I)+BMTX(3,3)*HJ
  204 XJP = XP(I)+BMTX(1,3)*HJ
      CAJ = (XP(I)-XJP)/HJ
      CBJ = (YP(I)-YJP)/HJ
      CGJ = (ZP(I)-ZJP)/HJ
      CALL INTRPL(FJPP,RWHJB,RWHJE,DRWHJ,RW(I)-HJ,FJ)
      SFRX(I) = SFRX(I)+FJ*CAJ
      SFRY(I) = SFRY(I)+FJ*CBJ
      SFRZ(I) = SFRZ(I)+FJ*CGJ
   10 XJ = XJ+RAD
   11 CONTINUE
      FR(I) = SQRT(SFRX(I)**2+SFRY(I)**2+SFRZ(I)**2)
      IF(FR(I).NE.0.0)GO TO 110
      CAR(I) = 0.0
      CBR(I) = 0.0
      CGR(I) = 0.0
      HI(I) = RW(I)
      RETURN
  110 CAR(I) = -SFRX(I)/FR(I)
      CBR(I) = -SFRY(I)/FR(I)
      CGR(I) = -SFRZ(I)/FR(I)
      HI(I) = RW(I)-FR(I)/AKT(I)
      IF(HI(I).GT.RW(I)-SIGT(I)) GO TO 111
      HI(I) = RW(I)-(FR(I)/AKT(I)+SIGT(I)*(XLAMT(I)-1.0))/XLAMT(I)
  111 TYGP = YP(I)+HI(I)*CBR(I)
      PHGI(I) = 0.0
      IF(TYGP.LE.YC1P)GO TO 12
      IF(TYGP.GT.YC1P.AND.TYGP.LE.YC2P) GO TO 900
      GO TO 905
  900 PHGI(I) = PHIC1R
      GO TO 12
  905 IF(NCRBSL.EQ.2) GO TO 970
      IF(TYGP.GT.YC2P.AND.TYGP.LE.YC3P) GO TO 910
      GO TO 915
  910 PHGI(I) = PHIC2R
      GO TO 12
  915 IF(NCRBSL.EQ.3) GO TO 970
      IF(TYGP.GT.YC3P.AND.TYGP.LE.YC4P) GO TO 920
      GO TO 925
  920 PHGI(I) = PHIC3R
      GO TO 12
  925 IF(NCRBSL.EQ.4) GO TO 970
      IF(TYGP.GT.YC4P.AND.TYGP.LE.YC5P) GO TO 930
      GO TO 935
  930 PHGI(I) = PHIC4R
      GO TO 12
  935 IF(NCRBSL.EQ.5) GO TO 970
      IF(TYGP.GT.YC5P.AND.TYGP.LE.YC6P) GO TO 940
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      GO TO 970                                                         CRBI2030
  940 PHGI(I) = PHIC5R                                                  CRBI2040
      GO TO 12                                                          CRBI2050
  970 PHGI(I) = PHICLR                                                  CRBI2060
   12 TCI = CAR(I)*CBYW(I)-CBR(I)*CAYW(I)                               CRBI2070
      TAI = CBR(I)*CGYW(I)-CGR(I)*CBYW(I)                               CRBI2080
      TBI = CGR(I)*CAYW(I)-CAR(I)*CGYW(I)                               CRBI2090
      CPG(I) = COS(PHGI(I))                                             CRBI2100
      SPG(I) = SIN(PHGI(I))                                             CRBI2110
      TERM3 = TBI*SPG(I)                                                CRBI2120
      TERM4 = TCI*CPG(I)                                                CRBI2130
      DN1 = TAI * (TERM3 - TERM4)                                       CRBI2140
      DN2 = -TBI*TERM4 - (TAI**2 + TCI**2)*SPG(I)                       CRBI2150
      DN3 =  (TAI**2 + TBI**2)*CPG(I)  + TCI*TERM3                      CRBI2160
      TERM5 = SQRT(DN1**2 + DN2**2 + DN3**2)                            CRBI2170
      SPG(I) = (-DN2/TERM5)                                             CRBI2180
      PHGI(I) = ARSIN(SPG(I))                                           CRBI2190
      THGI(I) = ATAN (DN1/DN3)                                          CRBI2200
      CPG(I) = COS(PHGI(I))                                             CRBI2210
      TERM6 = SQRT(DN1**2 + DN3**2)                                     CRBI2220
      CTG(I) = DN3/TERM6                                                CRBI2230
      STG(I) = DN1/TERM6                                                CRBI2240
C     STORE XGPP(I),YGPP(I) AS WELL AS ZGPP(I) IN CRBIMP FOR PLOTTING   CRBI2250
      XGPP(I) = XP(I) + HI(I) * CAR(I)                                  CRBI2260
      YGPP(I) = TYGP                                                    CRBI2270
      ZGPP(I) = ZP(I)+HI(I)*CGR(I)                                      CRBI2280
      RETURN                                                            CRBI2290
      END                                                               CRBI2300
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      SUBROUTINE DAUX                                                   DAUX0010
C             HVOSM-RD2 VERSION                                         DAUX0020
C             REVISED OCTOBER 1975   CALSPAN CORPORATION                DAUX0030
      COMMON/INPT/PHIO,THETAO,PSIO,PO,QO,RO,XCOP,YCOP,ZCOP,UO,VO,WO,    DAUX0040
     1            A,B,DEL10,DEL20,DEL30,PHIRO,DEL10D,DEL20D,DEL30D,     DAUX0050
     2            PHIROD,TF,TR,ZF,ZR,RHO,AKRS,XMUR,                     DAUX0060
     3            XMS,XMUF,XIX,XIY,XIZ,XIXZ,CF,AKF,XLAMF,OMEGF,CFP,EPSF,DAUX0070
     4            RF,CR,AKR,XLAMR,OMEGR,CRP,EPSR,RR,TS,THMAX,DTCOMP,TO, DAUX0080
     5            T1,DTCMP1,DTPRNT,MODE,EBAR,EM,AAA,HMAX,HMIN,BET,G,    DAUX0090
     6            HED(36),DADE(3),XIR,X1,Y1,Z1,X2,Y2,Z2,PHIC(50),DELB,  DAUX0100
     7            DELE,DDEL,NDEL,PSIF(50),TQF(50),TQR(50),TB,TE,TINCR,  DAUX0110
     8            NZTAB,NZ5,XBDRY(4,5),PSBDRY(4,5),YBDRY(2,5),NBX(5),   DAUX0120
     9            NBY(5),NTBL1,NTBL2,NTBL3,ZGP(21,21,5)                 DAUX0130
      COMMON/INPT/XB(5),XE(5),XINCR(5),NX(5),YB(5),YE(5),YINCR(5),NY(5),DAUX0140
     1         XXZGP5(21),YYZGP5(21),AMUG(5),PSBDRO(4,5),UVWMIN,PQRMIN  DAUX0150
      COMMON/INPT1/YC1P,YC2P,ZC2P,DELTC,PHIC1,PHIC2,AMUC,XIPS,          DAUX0160
     1             CPSP,OMGPS,AKPS,EPSPS,XPS,RWHJB,RWHJE,DRWHJ,INDCRB,  DAUX0170
     2             PSIFIO,PSIFDO                                        DAUX0180
      DIMENSION YCIP(2)                                                 DAUX0190
      EQUIVALENCE (YCIP(1),YC1P)                                        DAUX0200
      COMMON /INTG/NEQ,T,DT,VAR(50),DER(50)                             DAUX0210
      EQUIVALENCE (U,VAR(1)),(V,VAR(2)),(W,VAR(3)),(P,VAR(4)),(Q,VAR(5))DAUX0220
     1           ,(R,VAR(6)),(DEL1,VAR(7)),(DEL1D,VAR(8)),(DEL2,VAR(9)),DAUX0230
     2            (DEL2D,VAR(10)),(DEL3,VAR(11)),(DEL3D,VAR(12)),       DAUX0240
     3            (PHIR,VAR(13)),(PHIRD,VAR(14)),(THETTP,VAR(15)),      DAUX0250
     4            (PHITP,VAR(16)),(PSITP,VAR(17)),(XCP,VAR(18)),        DAUX0260
     5            (YCP,VAR(19)),(ZCP,VAR(20)),(PSIFI,VAR(21)),          DAUX0270
     6            (PSIFID,VAR(22))                                      DAUX0280
      EQUIVALENCE (DU,DER(1)),(DV,DER(2)),(DW,DER(3)),(DP,DER(4)),      DAUX0290
     1            (DQ,DER(5)),(DR,DER(6)),(DDEL1,DER(7)),(DDEL1D,DER(8))DAUX0300
     2           ,(DDEL2,DER(9)),(DDEL2D,DER(10)),(DDEL3,DER(11)),      DAUX0310
     3            (DDEL3D,DER(12)),(DPHIR,DER(13)),(DPHIRD,DER(14)),    DAUX0320
     4            (DTHTTP,DER(15)),(DPHITP,DER(16)),(DPSITP,DER(17)),   DAUX0330
     5            (DXCP,DER(18)),(DYCP,DER(19)),(DZCP,DER(20)),         DAUX0340
     6            (DPSIFI,DER(21)),(DDPSFI,DER(22))                     DAUX0350
      EQUIVALENCE (VAR(9),PHIF),(VAR(10),PHIFD),(DER(9),DPHIF),         DAUX0360
     1            (DER(10),DPHIFD)                                      DAUX0370
      EQUIVALENCE (VAR(13),DEL4),(VAR(14),DEL4D),(DER(13),DDEL4),       DAUX0380
     1            (DER(14),DDEL4D)                                      DAUX0390
      COMMON /DIMV/X1P,X2P,X3P,X4P,Y1P,Y2P,Y3P,Y4P,Z1P,Z2P,Z3P,Z4P,PHI1,DAUX0400
     1             PHI2,PHI3,PHI4,PSI1,PSI2,PSI3,PSI4,CAYW(4),CBYW(4),  DAUX0410
     2             CGYW(4),ZPGI(4),THGI(4),PHGI(4),CPG(4),SPG(4),CTG(4),DAUX0420
     3             STG(4),CAGZ(4),CBGZ(4),CGGZ(4),D1(4),D2(4),D3(4),    DAUX0430
     4             XLM1(4),XLM2(4),XLM3(4),AMTX(3,3),CMTX(3,4),XGPP(4), DAUX0440
     5             YGPP(4),ZGPP(4),DMATX(10,11),DELTA(4),CAR(4),CBR(4), DAUX0450
     6             CGR(4),FR(4),HI(4),FC(4),TI(4),AX(4),BX(4),CX(4),    DAUX0460
     7             CTXG(4),UG(4),STXG(4),AY(4),BY(4),CY(4),CPYG(4),     DAUX0470
     8             SPYG(4),VG(4),PSIIP(4),PHICI(4),CAC(4),CBC(4),CGC(4),DAUX0480
     9             FCXU(4),FCYU(4),FCZU(4),FS(4),CAXW(4),CBXW(4),CGXW(4)DAUX0490
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      COMMON /DIMV/AS(4),BS(4),CS(4),CAS(4),CBS(4),CGS(4),BETP(4),
     1           BETBR(4),FSXU(4),FSYU(4),FSZU(4),FRXU(4),FRYU(4),
     2           FRZU(4),FXU(4),FYU(4),FZU(4),SI(4),F1FI(2),F1RI(2),
     3           F2FI(2),F2RI(2),CAH(4),CBH(4),CGH(4)
      DIMENSION XP(4),YP(4),ZP(4),PHII(4),PSII(4)
      EQUIVALENCE (XP(1),X1P),(YP(1),Y1P),(ZP(1),Z1P),(PHII(1),PHI1),
     1           (PSII(1),PSI1)
      COMMON /COMP/SUMM,THETN,PHIN,PSIN,PI,RAD,GAM1,GAM2,GAM3,GAM4,GAM5,
     1          GAM6,GAM7,GAM8,GAM9,THETT,PHIT,PSIT,ZRO,TRO2,
     2           TFO2,TIZ,RHO2,RHOMUR,AMUF,BMUR,ZPR,TM4,RHMR2,AO2APB,
     3           BO2APB,RFTF,TSO2,RRTS,BROMUR,XMUFO2,AXMFO2,XMTFO4,
     4           XIZR,RTR,RHMR2I,XIXP,XIZP,XIXZP,XIYZP,D1PD2,D1MD2,
     5           ZRD3,ZRD3R,ZFD3R,ZFD12,TIZ2,TG61,DD1P2,DD1M2,RPR,PHRP
     6          ,TANTP,SPHTP,CPHTP,SECTP,SFXS,SFYS,SFZS,SNPS,SNTS,
     7           SNPSS,TPR,CAY,CBY,CGY,CAX,CBX,CGX,SFYU,SFXU,SFYUF,
     8           SFYUR,SFZU,COSTH,SINTH,COSPS,SINPS,COSPH,SINPH,ANG1,
     9           ANG2,CPHI,SPHI,CPSI,SPSI,P1,P7,P3,P4,P5,P6,TX,TY,TZ
      COMMON /COMP/TRH,DISTX,DISTY,DISTD,DISTS,D21,ZETA4,ZETA4D,ZETA3,
     1           ZETA3D,SFZ1,SNPU,SNTU,HCGH1,HCGH2,HCGH3,HCGH4,TERM1,
     2           TERM2,SNPSU,SNPR,HCBH1,HCBH2,HCBH3,HCBH4,HCAH1,HCAH2,
     3           HCAH3,HCAH4,UQ,WP,UR,QR,VP,PR,P2,Q2,R2,VR,WQ,PQ,PHIR2
     4          ,PHIRD2,RPHRD,GCTH,GSTH,GCTSP,GCTCP,XXX,YYY,IX,IY,XX1,
     5           XX2,YY1,YY2,THG1,THG2,PHG1,PHG2,ZZ1,ZZ2,LLL
      DIMENSION HCAH(4),HCBH(4),HCGH(4)
      EQUIVALENCE (HCAH(1),HCAH1),(HCBH(1),HCBH1),(HCGH(1),HCGH1)
      COMMON /COMPN/ FRSP(4),FRCP(4),ICBHIT,JCBHIT,
     1               DPSINT,TANPC1,TANPC2,PHIC1R,PHIC2R,AMUCMP,PHI1D,
     2               PHI2D,LCB1(4),LCB2(4),IHIT,AJMTX(3,3),BMTX(3,3),
     3               SFRX(4),SFRY(4),SFRZ(4),T1PSI,T2PSI,XMUGI(4)
      LOGICAL LCB1,LCB2
      COMMON/ADTNL/ U1,U2,U3,U4,V1,V2,V3,V4,W1,W2,W3,W4,
     1              XIYP,SPHIC,CPHIC,APTCH1,APTCH2,APTCH3,APTCH4,
     2              SLOPE1,SLOPE2,XTRA(300)
      DIMENSION UI(4),VI(4),WI(4)
      EQUIVALENCE (UI(1),U1),(VI(1),V1),(WI(1),W1)
      DIMENSION APITCH(4)
      EQUIVALENCE (APITCH(1),APTCH1)
      COMMON /INPT2/ YBPO,ZBTP,ZBBP,XVF,XVR,YV,ZVT,ZVB,AKV,SIGR(11),
     1               SET,CONS,AMUB,EPSV,EPSB,XM,EPST,DDD,INDB,DELYBP,
     2               DELTB,XINPT(100)
      COMMON /INSUS/ XIF,RHOF,TSF,PHIFO,PHIFOD,DEL40,DEL40D,ISUS,
     1               AKDS,AKDS1,AKDS2,AKDS3,PHIRC(50),DTHF(50),DTHR(50),
     2               NCAMF,NCAMR,NDTHF,NDTHR
      COMMON /SUSCMP/ XMURO2,BXMRO2,XMTRO4,ZFO,TSFO2,RHOF2,RHFMUF,
     1                RHF2MF,RF2MFI,RTF,RRTR,D3PD4,D3MD4,D43,DD3P4,
     2                DD3M4,ZFD1RF,ZRD34,RFPF,RPF2M,WFMF,PHFP,PHIF2,
     3                PHIFD2,RPHFD,ZFD1,ZFD2,ZRD4,TPF,SLOPE3,SLOPE4,
     4                PHI3D,PHI4D,DTHF1,DTHF2,DTHR3,DTHR4,DTDD1,
     5                DTDD2,DTDD3,DTDD4,FJF(4),SNPF
      COMMON/NSTOP/ISTOP
      DIMENSION DISP(4),VEL(4)
```

```
C                                                                       DAUX1010
      IF(ISTOP.NE.0) RETURN                                             DAUX1020
      CALL TMCNST                                                       DAUX1030
      IS1 = ISUS+1                                                      DAUX1040
      D12D22 = DEL1*DEL1 + DEL2*DEL2                                    DAUX1050
      GO TO (10,11,12),IS1                                              DAUX1060
   10 XIXP = XMUF*(ZF*(ZF+D1PD2)+.5*D12D22) + XMUR*ZRD3*ZRD3R           DAUX1070
      XIYP = XIXP+RHOMUR*ZRD3R                                          DAUX1080
      XIZP = TIZ+TIZ2                                                   DAUX1090
      XIXZP = AMUF*ZFD12 - BMUR*ZRD3                                    DAUX1100
      XIYZP = TM4*D1MD2-RHOMUR*PHIR*ZRD3R                               DAUX1110
      GAM2 = XMUF*ZFD12+XMUR*ZRD3R                                      DAUX1120
      GAM3 = GAM2-RHOMUR                                                DAUX1130
      GAM4 = XIYZP+RHMR2*PHIR                                           DAUX1140
      GAM5 = TIZ-XMUF*TFO2*TF-TIZ2                                      DAUX1150
      GAM6 = XMUF*DD1P2+2.0*TG61                                        DAUX1160
      GAM7 = XMUF*(ZF*DD1P2+DEL1*DEL1D+DEL2*DEL2D)+2.0*ZRD3*TG61        DAUX1170
      GAM8 = 2.0*(TM4*DD1M2-RPR*TG61)                                   DAUX1180
      GAM9 = AMUF*DD1P2 - 2.0*B*TG61                                    DAUX1190
      GO TO 3                                                           DAUX1200
   11 XIXP = XMUFO2*(ZFD1*ZFD1+ZFD2*ZFD2) + XMURO2*(ZRD3*ZRD3+ZRD4*ZRD4)DAUX1210
      XIYP = XIXP                                                       DAUX1220
      XIZP = XMUF*(A*A+TFO2*TFO2) +XMUR*(B*B+TRO2*TRO2)                 DAUX1230
      XIXZP = AXMFO2*(ZFD1+ZFD2) -  BXMRO2*(ZRD3+ZRD4)                  DAUX1240
      XIYZP = XMTFO4*D1MD2 + XMTRO4*D3MD4                               DAUX1250
      GAM2 = XMUF*ZFD12 + XMUR*ZRD34                                    DAUX1260
      GAM5 = XMUF*(A*A-TFO2*TFO2) + XMUR*(B*B-TRO2*TRO2)                DAUX1270
      GAM6 = XMUF*DD1P2 + XMUR*DD3P4                                    DAUX1280
      GAM7 = XMUF*(ZFD1*DEL1D+ZFD2*DEL2D) + XMUR*(ZRD3*DEL3D+ZRD4*DEL4D)DAUX1290
      GAM8 = XMUF*TFO2*DD1M2 + XMUR*TRO2*DD3M4                          DAUX1300
      GAM9 = AMUF*DD1P2 - BMUR*DD3P4                                    DAUX1310
      GO TO 3                                                           DAUX1320
   12 XIXP = XMUF*ZFD1*ZFD1 + RHFMUF*ZFD1 + XMUR*ZRD3*ZRD3 + RHOMUR*ZRD3DAUX1330
      XIYP = XIXP + RHFMUF*ZFD1RF + RHOMUR*ZRD3R                        DAUX1340
      XIZP = XMUF*(A*A+RFPF*RFPF) + XMUR*(B*B+RPR*RPR)                  DAUX1350
      XIXZP = AMUF*ZFD1 - BMUR*ZRD3                                     DAUX1360
      XIYZP = -XMUF*RFPF*ZFD1RF - XMUR*RPR*ZRD3R                        DAUX1370
      GAM2 = XMUF*ZFD1RF + XMUR*ZRD3R                                   DAUX1380
      GAM3 = GAM2 - RHFMUF - RHOMUR                                     DAUX1390
      GAM4 = XIYZP + RHF2MF*PHIF + RHMR2*PHIR                           DAUX1400
      GAM5 = XMUF*(A*A-RFPF*RFPF) + XMUR*(B*B-RPR*RPR)                  DAUX1410
      GAM6 = 2.0*WFMF + 2.0*TG61                                        DAUX1420
      GAM7 = 2.0*ZFD1*WFMF + 2.0*ZRD3*TG61                              DAUX1430
      GAM8 = -2.0*RFPF*WFMF - 2.0*RPR*TG61                              DAUX1440
      GAM9 = 2.0*A*WFMF - 2.0*B*TG61                                    DAUX1450
    3 CALL VPOS                                                         DAUX1460
      CALL VGORNT                                                       DAUX1470
      IF(ISUS.EQ.2) GO TO 20                                            DAUX1480
      DISP(1) = DEL1                                                    DAUX1490
      DISP(2) = DEL2                                                    DAUX1500
      VEL(1) = DEL1D                                                    DAUX1510
```

```
      VEL(2) = DEL2D
      GO TO 21
   20 DISP(1) = DEL1+TSFO2*PHIF
      DISP(2) = DEL1-TSFO2*PHIF
      VEL(1) = DEL1D+TSFO2*PHIFD
      VEL(2) = DEL1D-TSFO2*PHIFD
      GO TO 22
   21 IF(ISUS.NE.1) GO TO 22
      DISP(3) = DEL3
      DISP(4) = DEL4
      VEL(3) = DEL3D
      VEL(4) = DEL4D
      GO TO 23
   22 DISP(3) = DEL3+TSO2*PHIR
      DISP(4) = DEL3-TSO2*PHIR
      VEL(3) = DEL3D+TSO2*PHIRD
      VEL(4) = DEL3D-TSO2*PHIRD
   23 CALL SUSFRC(DISP,VEL)
      CALL UMOMNT(ISUS)
      IF(INDB.NE.0) CALL SFORCE
      GO TO (30,31,32),IS1
   30 CALL MATRIX
      GO TO 34
   31 CALL MTRXIR
      GO TO 34
   32 CALL MTRXSF
   34 CALL SIMSOL(DMATX,10,10)
      DU = DMATX(1,11)
      DV = DMATX(2,11)
      DW = DMATX(3,11)
      DP = DMATX(4,11)
      DQ = DMATX(5,11)
      DR = DMATX(6,11)
      DXCP = AMTX(1,1)*U + AMTX(1,2)*V + AMTX(1,3)*W
      DYCP = AMTX(2,1)*U + AMTX(2,2)*V + AMTX(2,3)*W
      DZCP = AMTX(3,1)*U + AMTX(3,2)*V + AMTX(3,3)*W
      DTHTTP = Q*CPHTP - R*SPHTP
      DPHITP = P + (Q*SPHTP + R*CPHTP)*TANTP
      DPSITP = (Q*SPHTP + R*CPHTP)*SECTP
      IF(ISUS.EQ.2) GO TO 40
      DDEL1D = DMATX(7,11)
      DDEL2D = DMATX(8,11)
      DDEL1 = DEL1D
      DDEL2 = DEL2D
      GO TO 41
   40 DDEL1D = DMATX(7,11)
      DPHIFD = DMATX(8,11)
      DDEL1 = DEL1D
      DPHIF = PHIFD
      GO TO 43
   41 IF(ISUS.NE.1) GO TO 43
```

```
      DDEL3D = DMATX(9,11)                                              DAUX2030
      DDEL4D = DMATX(10,11)                                             DAUX2040
      DDEL3 = DEL3D                                                     DAUX2050
      DDEL4 = DEL4D                                                     DAUX2060
      GO TO 44                                                          DAUX2070
   43 DDEL3D = DMATX(9,11)                                              DAUX2080
      DPHIRD = DMATX(10,11)                                             DAUX2090
      DDEL3 = DEL3D                                                     DAUX2100
      DPHIR = PHIRD                                                     DAUX2110
   44 CONTINUE                                                          DAUX2120
      IF(IHIT.EQ.0.AND.INDCRB.GE.0) RETURN                              DAUX2130
      DPSIFI = PSIFID                                                   DAUX2140
      T1PSI = 0.0                                                       DAUX2150
      T2PSI = 0.0                                                       DAUX2160
      IF(ABS(PSIFID).GT.EPSPS) T1PSI = SIGN(CPSP,PSIFID)                DAUX2170
      IF(SIGN(1.,PSIFID) .NE. SIGN(1.,PSIFI)) GO TO 7                   DAUX2180
      ABSPSF = ABS(PSIFI)                                               DAUX2190
      IF(ABSPSF .GT. OMGPS) T2PSI=SIGN((AKPS*(ABSPSF-OMGPS)),PSIFI)     DAUX2200
    7 DDPSFI = (FYU(1)*(HCAH1-XPS*COS(PSIIP(1))*CTXG(1))+               DAUX2210
     1           FYU(2)*(HCAH2-XPS*COS(PSIIP(2))*CTXG(2))-              DAUX2220
     2         FXU(1)*(HCBH1+PHI1*HCGH1)-FXU(2)*(HCBH2+PHI2*HCGH2)-     DAUX2230
     3          T1PSI-T2PSI+FZU(1)*HCAH1*PHI1+FZU(2)*HCAH2*PHI2)/XIPS   DAUX2240
      RETURN                                                            DAUX2250
      END                                                               DAUX2260
```

```
      SUBROUTINE DRIVER(/SA/,/SADOT/,/ISA/)                              DRIV0010
C             HVOSM-RD2 VERSION                                          DRIV0020
C.            REVISED OCTOBER 1975  CALSPAN CORPORATION                  DRIV0030
      ISA = 0                                                            DRIV0040
      RETURN                                                             DRIV0050
      END                                                                DRIV0060
```

```
      SUBROUTINE DRIVID                                                 DRVD0010
C              HVOSM-RD2 VERSION                                        DRVD0020
C              REVISED OCTOBER 1975  CALSPAN CORPORATION                DRVD0030
      RETURN                                                            DRVD0040
      END                                                               DRVD0050
```

```
      SUBROUTINE EGYSUM
C             HVOSM-RD2 VERSION
C             REVISED OCTOBER 1975   CALSPAN CORPORATION
      COMMON /INPT2/ YBPO,ZBTP,ZBBP,XVF,XVR,YV,ZVT,ZVB,AKV,SIGR(11),
     1               SET,CONS,AMUB,EPSV,EPSB,XM,EPST,DDD,INDB,DELYBP,
     2               DELTB,XINPT(100)
      COMMON/BARIER/FN,IBHIT,JBHIT,XCPNP(3),YCPNP(3),ZCPNP(3),XCPN(3),
     1              YCPN(3),ZCPN(3),AA1(17),BB1(17),CC1(17),RR1(17),
     2              AA2(17),BB2(17),CC2(17),RR2(17),CAB,CBB,CGB,CABT,
     3              CBBT,CGBT,RB,XBT,YBT,ZBT,XBB,YBB,ZBB,RR2P(17),
     4              YBPT,XNN(17),YNN(17),ZNN(17),XMTX(3,4),IDPT(17),IPT
     5              ,ININD,UNP(17),VNP(17),WNP(17),VMAX(4),I1,I2,I3,I4,
     6              XCPTP,YCPTP,ZCPTP,XCPBP,YCPBP,ZCPBP,YCPMP,AINTI,
     7              AINTP,SXR,SYR,SZR,SDEN,XRI,YRI,ZRI,FRICT,DELBB,VTAN,
     8              FNP,FB,URP,VRP,WRP,EPSL,XLDP,DELX,VL,NCYC,EEE,ENRGY,
     9              NSEG,YBPTP,PCAB,PCBB,PCGB,PPRB,CAB1,CBB1,CGB1,
     A              RB1,NUNLD,NLDCTR,VDEF,PVDEF,PSZR,XF,DELBBP,
     B              SWORK,SPENGY,DISS,IPLN,ILOAD
      DIMENSION INDXPT(4)
      EQUIVALENCE (INDXPT(1),I1)
    1 DISS = ENRGY-EEE
      SWORK = SWORK+FRICT*VTAN*DT
      IF(FN.EQ.0.0) GO TO 2
      SPENGY = SPENGY+.5*(FN+FNP)*(VDEF-PVDEF)
    2 PVDEF = VDEF
      FNP = FN
      IF(FN.EQ.0.0)DELBB = EPSL+SET*DELX
      DELBBP = DELBB
      IF(ININD.EQ.1)ININD = 2
      PPRB = RB
      PCAB = CAB
      PCBB = CBB
      PCGB = CGB
      YBPTP = YBPT
      PSZR = SZR
      RETURN
      END
```

```
      SUBROUTINE GCP(I)
C              HVOSM-RD2 VERSION
C              REVISED OCTOBER 1975   CALSPAN CORPORATION
      COMMON /DIMV/X1P,X2P,X3P,X4P,Y1P,Y2P,Y3P,Y4P,Z1P,Z2P,Z3P,Z4P,PHI1,
     1               PHI2,PHI3,PHI4,PSI1,PSI2,PSI3,PSI4,CAYW(4),CBYW(4),
     2               CGYW(4),ZPGI(4),THGI(4),PHGI(4),CPG(4),SPG(4),CTG(4),
     3               STG(4),CAGZ(4),CBGZ(4),CGGZ(4),D1(4),D2(4),D3(4),
     4               XLM1(4),XLM2(4),XLM3(4),AMTX(3,3),CMTX(3,4),XGPP(4),
     5               YGPP(4),ZGPP(4),DMATX(10,11),DELTA(4),CAR(4),CBR(4),
     6               CGR(4),FR(4),HI(4),FC(4),TI(4),AX(4),BX(4),CX(4),
     7               CTXG(4),UG(4),STXG(4),AY(4),BY(4),CY(4),CPYG(4),
     8               SPYG(4),VG(4),PSIIP(4),PHICI(4),CAC(4),CBC(4),CGC(4),
     9               FCXU(4),FCYU(4),FCZU(4),FS(4),CAXW(4),CBXW(4),CGXW(4)
      COMMON /DIMV/AS(4),BS(4),CS(4),CAS(4),CBS(4),CGS(4),BETP(4),
     1               BETBR(4),FSXU(4),FSYU(4),FSZU(4),FRXU(4),FRYU(4),
     2               FRZU(4),FXU(4),FYU(4),FZU(4),SI(4),F1FI(2),F1RI(2),
     3               F2FI(2),F2RI(2),CAH(4),CBH(4),CGH(4)
      DIMENSION XP(4),YP(4),ZP(4),PHII(4),PSII(4)
      EQUIVALENCE (XP(1),X1P),(YP(1),Y1P),(ZP(1),Z1P),(PHII(1),PHI1),
     1            (PSII(1),PSI1)
      COMMON /COMP/SUMM,THETN,PHIN,PSIN,PI,RAD,GAM1,GAM2,GAM3,GAM4,GAM5,
     1             GAM6,GAM7,GAM8,GAM9,THETT,PHIT,PSIT,ZRO,TRO2,
     2               TFO2,TIZ,RHO2,RHOMUR,AMUF,BMUR,ZPR,TM4,RHMR2,AO2APB,
     3               BO2APB,RFTF,TSO2,RRTS,BROMUR,XMUFO2,AXMFO2,XMTFO4,
     4               XIZR,RTR,RHMR2I,XIXP,XIZP,XIXZP,XIYZP,D1PD2,D1MD2,
     5               ZRD3,ZRD3R,ZFD3R,ZFD12,TIZ2,TG61,DD1P2,DD1M2,RPR,PHRP
     6             ,TANTP,SPHTP,CPHTP,SECTP,SFXS,SFYS,SFZS,SNPS,SNTS,
     7               SNPSS,TPR,CAY,CBY,CGY,CAX,CBX,CGX,SFYU,SFXU,SFYUF,
     8               SFYUR,SFZU,COSTH,SINTH,COSPS,SINPS,COSPH,SINPH,ANG1,
     9               ANG2,CPHI,SPHI,CPSI,SPSI,P1,P7,P3,P4,P5,P6,TX,TY,TZ
      COMMON /COMP/TRH,DISTX,DISTY,DISTD,DISTS,D21,ZETA4,ZETA4D,ZETA3,
     1               ZETA3D,SFZ1,SNPU,SNTU,HCGH1,HCGH2,HCGH3,HCGH4,TERM1,
     2               TERM2,SNPSU,SNPR,HCBH1,HCBH2,HCBH3,HCBH4,HCAH1,HCAH2,
     3               HCAH3,HCAH4,UQ,WP,UR,QR,VP,PR,P2,Q2,R2,VR,WQ,PQ,PHIR2
     4             ,PHIRD2,RPHRD,GCTH,GSTH,GCTSP,GCTCP,XXX,YYY,IX,IY,XX1,
     5               XX2,YY1,YY2,THG1,THG2,PHG1,PHG2,ZZ1,ZZ2,LLL
      DIMENSION HCAH(4),HCBH(4),HCGH(4)
      EQUIVALENCE (HCAH(1),HCAH1),(HCBH(1),HCBH1),(HCGH(1),HCGH1)
      COMMON /TIRIN/ AKT(4),SIGT(4),XLAMT(4),AO(4),A1(4),A2(4),A3(4),
     1                  A4(4),OMEGT(4),AMU(4),RW(4),FJP(35,4),A234(4),
     2                  A12(4),OMT2A2(4),OMT2M1(4),A23(4),ITIR(4)
    1  XLM1(I) = XP(I)*CAYW(I)+YP(I)*CBYW(I)+ZP(I)*CGYW(I)
      XLM2(I) = XP(I)*CAGZ(I)+YP(I)*CBGZ(I)+ZPGI(I)*CGGZ(I)
      XLM3(I) = D1(I)*XP(I)+D2(I)*YP(I)+D3(I)*ZP(I)
    2 CMTX(1,1) = CAYW(I)
      CMTX(1,2) = CBYW(I)
      CMTX(1,3) = CGYW(I)
      CMTX(1,4) = XLM1(I)
      CMTX(2,1) = CAGZ(I)
```

```
      CMTX(2,2) = CBGZ(I)
      CMTX(2,3) = CGGZ(I)
      CMTX(2,4) = XLM2(I)
      CMTX(3,1) = D1(I)
      CMTX(3,2) = D2(I)
      CMTX(3,3) = D3(I)
      CMTX(3,4) = XLM3(I)
      CALL SIMSOL(CMTX,3,3)
    3 XGPP(I) = CMTX(1,4)
      YGPP(I) = CMTX(2,4)
      ZGPP(I) = CMTX(3,4)
      TX = XGPP(I)-XP(I)
      TY = YGPP(I)-YP(I)
      TZ = ZGPP(I)-ZP(I)
      DELTA(I) = SQRT(TX**2+TY**2+TZ**2)
      CAR(I) = TX/DELTA(I)
      CBR(I) = TY/DELTA(I)
      CGR(I) = TZ/DELTA(I)
      HI(I) = AMIN1(DELTA(I),RW(I))
    4 FR(I) = 0.0
      IF(RW(I).EQ.HI(I)) RETURN
      TRH = RW(I)-HI(I)
      IF(TRH.GT.SIGT(I)) GO TO 5
      FR(I) = AKT(I)*TRH
      RETURN
    5 FR(I) = AKT(I)*(XLAMT(I)*(TRH-SIGT(I))+SIGT(I))
      RETURN
      END
```

```
      SUBROUTINE IDOUT                                                  IDOT0010
C           HVOSM-RD2 VERSION                                           IDOT0020
C           REVISED OCTOBER 1975  CALSPAN CORPORATION                   IDOT0030
      COMMON/HEAD/ VHED(20),CHED(20),GHED(20),SHED(20),THED(20),        IDOT0040
     1             NPAGE(20)                                            IDOT0050
      COMMON/INPT/PHIO,THETAO,PSIO,PO,QO,RO,XCOP,YCOP,ZCOP,UO,VO,WO,    IDOT0060
     1            A,B,DEL10,DEL20,DEL30,PHIRO,DEL10D,DEL20D,DEL30D,     IDOT0070
     2            PHIROD,TF,TR,ZF,ZR,RHO,AKRS,XMUR,                     IDOT0080
     3            XMS,XMUF,XIX,XIY,XIZ,XIXZ,CF,AKF,XLAMF,OMEGF,CFP,EPSF,IDOT0090
     4            RF,CR,AKR,XLAMR,OMEGR,CRP,EPSR,RR,TS,THMAX,DTCOMP,TO, IDOT0100
     5            T1,DTCMP1,DTPRNT,MODE,EBAR,EM,AAA,HMAX,HMIN,BET,G,    IDOT0110
     6            HED(36),DADE(3),XIR,X1,Y1,Z1,X2,Y2,Z2,PHIC(50),DELB,  IDOT0120
     7            DELE,DDEL,NDEL,PSIF(50),TQF(50),TQR(50),TB,TE,TINCR,  IDOT0130
     8            NZTAB,NZ5,XBDRY(4,5),PSBDRY(4,5),YBDRY(2,5),NBX(5),   IDOT0140
     9            NBY(5),NTBL1,NTBL2,NTBL3,ZGP(21,21,5)                 IDOT0150
      COMMON/INPT/XB(5),XE(5),XINCR(5),NX(5),YB(5),YE(5),YINCR(5),NY(5),IDOT0160
     1        XXZGP5(21),YYZGP5(21),AMUG(5),PSBDRO(4,5),UVWMIN,PQRMIN   IDOT0170
      COMMON/INPT1/YC1P,YC2P,ZC2P,DELTC,PHIC1,PHIC2,AMUC,XIPS,          IDOT0180
     1             CPSP,OMGPS,AKPS,EPSPS,XPS,RWHJB,RWHJE,DRWHJ,INDCRB,  IDOT0190
     2             PSIFIO,PSIFDO                                        IDOT0200
      DIMENSION YCIP(2)                                                 IDOT0210
      EQUIVALENCE (YCIP(1),YC1P)                                        IDOT0220
      COMMON /COMP/SUMM,THETN,PHIN,PSIN,PI,RAD,GAM1,GAM2,GAM3,GAM4,GAM5,IDOT0230
     1            GAM6,GAM7,GAM8,GAM9,THETT,PHIT,PSIT,ZRO,TRO2,         IDOT0240
     2             TFO2,TIZ,RHO2,RHOMUR,AMUF,BMUR,ZPR,TM4,RHMR2,AO2APB, IDOT0250
     3             BO2APB,RFTF,TSO2,RRTS,BROMUR,XMUFO2,AXMFO2,XMTFO4,   IDOT0260
     4             XIZR,RTR,RHMR2I,XIXP,XIZP,XIXZP,XIYZP,D1PD2,D1MD2,   IDOT0270
     5             ZRD3,ZRD3R,ZFD3R,ZFD12,TIZ2,TG61,DD1P2,DD1M2,RPR,PHRPIDOT0280
     6            ,TANTP,SPHTP,CPHTP,SECTP,SFXS,SFYS,SFZS,SNPS,SNTS,    IDOT0290
     7             SNPSS,TPR,CAY,CBY,CGY,CAX,CBX,CGX,SFYU,SFXU,SFYUF,   IDOT0300
     8             SFYUR,SFZU,COSTH,SINTH,COSPS,SINPS,COSPH,SINPH,ANG1, IDOT0310
     9             ANG2,CPHI,SPHI,CPSI,SPSI,P1,P7,P3,P4,P5,P6,TX,TY,TZ  IDOT0320
      COMMON /COMP/TRH,DISTX,DISTY,DISTD,DISTS,D21,ZETA4,ZETA4D,ZETA3,  IDOT0330
     1             ZETA3D,SFZ1,SNPU,SNTU,HCGH1,HCGH2,HCGH3,HCGH4,TERM1, IDOT0340
     2             TERM2,SNPSU,SNPR,HCBH1,HCBH2,HCBH3,HCBH4,HCAH1,HCAH2,IDOT0350
     3             HCAH3,HCAH4,UQ,WP,UR,QR,VP,PR,P2,Q2,R2,VR,WQ,PQ,PHIR2IDOT0360
     4            ,PHIRD2,RPHRD,GCTH,GSTH,GCTSP,GCTCP,XXX,YYY,IX,IY,XX1,IDOT0370
     5             XX2,YY1,YY2,THG1,THG2,PHG1,PHG2,ZZ1,ZZ2,LLL          IDOT0380
      DIMENSION HCAH(4),HCBH(4),HCGH(4)                                 IDOT0390
      EQUIVALENCE (HCAH(1),HCAH1),(HCBH(1),HCBH1),(HCGH(1),HCGH1)       IDOT0400
      COMMON /INPT2/ YBPO,ZBTP,ZBBP,XVF,XVR,YV,ZVT,ZVB,AKV,SIGR(11),    IDOT0410
     1               SET,CONS,AMUB,EPSV,EPSB,XM,EPST,DDD,INDB,DELYBP,   IDOT0420
     2               DELTB,XINPT(100)                                   IDOT0430
      COMMON/INPT3/ AKFC,AKFCP,OMEGFC,AKFE,AKFEP,OMEGFE,AKRC,AKRCP,     IDOT0440
     1              OMEGRC,AKRE,AKREP,OMEGRE,END3                       IDOT0450
      COMMON/APTABL/ APFR(21,2),IAPFR(2),DAPFB,DAPFE,DDAPF,NAPF,        IDOT0460
     1               DAPRB,DAPRE,DDAPR,NAPR                             IDOT0470
      DIMENSION APF(21),APR(21)                                         IDOT0480
      EQUIVALENCE (APFR(1,1),APF(1)),(APFR(1,2),APR(1))                 IDOT0490
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      COMMON /TIRIN/ AKT(4),SIGT(4),XLAMT(4),A0(4),A1(4),A2(4),A3(4),
     1               A4(4),OMEGT(4),AMU(4),RW(4),FJP(35,4),A234(4),
     2               A12(4),OMT2A2(4),OMT2M1(4),A23(4),ITIR(4)
      COMMON /INSUS/ XIF,RHOF,TSF,PHIF0,PHIF0D,DEL40,DEL40D,ISUS,
     1               AKDS,AKDS1,AKDS2,AKDS3,PHIRC(50),DTHF(50),DTHR(50),
     2               NCAMF,NCAMR,NDTHF,NDTHR
      COMMON/NEWCRB/ YC3P,YC4P,YC5P,YC6P,YCLP,
     1               ZC3P,ZC4P,ZC5P,ZC6P,ZCLP,
     2               PHIC3,PHIC4,PHIC5,PHIC6,NCRBSL,
     3               TANPC3,TANPC4,TANPC5,TANPC6,TANPCL,
     4               PHIC3R,PHIC4R,PHIC5R,PHIC6R,PHICLR,
     5               YCMP(6),ZCMP(6),PHICM(6)
      COMMON/BARSTR/XSTI0(3),YSTI0(3),ZSTI0(3),XSTI(3),YSTI(3),
     1             ZSTI(3),YSTIP0(3),XSTIP(3),YSTIP(3),ZSTIP(3),
     2             FNSTI(3),AKST(3)
C
      DATA ZERO/0.0/
      DIMENSION TTARG(50) ,NTARG(10)
      DATA TTARG/50*0.0/ , NTARG/10*0/
      DIMENSION TXARG(21), TYARG(21)
      DATA TXARG/21*0.0/,TYARG/21*0.0/
      DATA CON1/4HCONS/, VARI/4HVARI/
      DIMENSION DINCH(2),DEG(2),DIPS(2),DPS(2),PS2PI(3),PS2I(3),
     1          DIPS2(3),PIPR(3),RAPRA(2),RADS(2),RPI(2),RPI2(3),
     2          RPI3(3),PPI(2),PPI3(2),PSPI(3),RAPS(2)
      DATA DINCH/4HINCH,4HES  /,  DEG/4HDEGR,4HEES /
      DATA   DPS/4HDEG/,4HSEC /, DIPS/4HIN/S,4HEC  /
      DATA RAPRA/4HRAD/,4HRAD /, RADS/4HRADI,4HANS /
      DATA   RPI/4HRAD/,4HIN  /,  PPI/4HLB/I,4HN   /
      DATA  PPI3/4HLB/I,4HN**3/, RAPS/4HRAD/,4HSEC /
      DATA PS2PI/4HLB-S,4HEC**,4H2/IN/, PS2I/4HLB-S,4HEC**,4H2-IN/
      DATA DIPS2/4HIN/S,4HEC**,4H2   /, PIPR/4HLB-I,4HN/RA,4HD    /
      DATA  RPI2/4HRAD/,4HIN**,4H2   /, RPI3/4HRAD/,4HIN**,4H3    /
      DATA  PSPI/4HLB-S,4HEC/I,4HN   /
      DATA SEC/4HSEC /
      DIMENSION PDI(2)
      DATA PDI/4HLB-I,4HN   /,PD/4HLB  /
      DIMENSION  TD1(2),TD2(2)
      DATA UD2/4HDEL2/,UPF/4HPHIF/,UD4/4HDEL4/,UPR/4HPHIR/
      DATA UDE/4HO  =/,UVE/4HOD =/
      DIMENSION TNU2(2),TNU3(3)
      DATA TNU2/4HNOT ,4HUSED/, TNU3/4HNOT ,4HUSED,4H    /
      DIMENSION TD3(2),T3D1(3),T3D2(3)
C
   11 WRITE(6,1000) (HED(I),I=1,18),DADE(1),DADE(2),
     1     (VHED(I),I=1,10),(THED(I),I=1,10),(CHED(I),I=1,10),
     2     (GHED(I),I=1,10),(SHED(I),I=1,10)
 1000 FORMAT(1H1,9X,18A4,30X,2A4 / 5X,3(10A4) / 5X,2(10A4) / )
      WRITE(6,1001) T0,SEC,T1,SEC,DTCOMP,SEC,MODE,DTPRNT,SEC
 1001 FORMAT(1H0,24X,39HP R O G R A M   C O N T R O L   D A T A /
     1 10X,38HSTART TIME                    T0     =,F10.4,2X,A4 /
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   2 10X,38HEND TIME                          T1      =,F10.4,2X,A4 /
   3 10X,38HINTEGRATION INCREMENT             DTCOMP  =,F10.4,2X,A4 /
   4 62X,30H(0=VARIABLE STEP ADAMS-MOULTON    /
   5 10X,38HINTEGRATION MODE                  MODE    =,I5,
   6  8X,16H-)1= RUNGA-KUTTA    /
   7 62X,28H(2= FIXED STEP ADAMS-MOULTON   /
   8 10X,38HPRINT INTERVAL                    DTPRNT  =,F10.4,2X,A4 )
    WRITE(6,1002) ISUS,INDCRB,DELTC,SEC
1002 FORMAT(1H ,
   1 61X,50H(0= INDEPENDENT FRONT SUSPENSION, SOLID REAR AXLE   /
   2 10X,38HSUSPENSION OPTION                 ISUS    =,I5,
   3  8X,42H-)1= INDEPENDENT FRONT AND REAR SUSPENSION   /
   4 62X,42H(2= SOLID FRONT AND REAR AXLES               /
   5 62X,42H(0= NO CURB, NO STEER DEGREE OF FREEDOM      /
   6 10X,38HCURB/STEER OPTION                 INDCRB =,I5,
   7  8X,10H-)1= CURB     /
   8 62X,42H(-1=STEER DEGREE OF FREEDOM, NO CURB         /
   9 10X,38HCURB INTEGRATION INCR.            DELTC   =,F10.5,2X,A4   )
    WRITE(6,1003) INDB,DELTB,SEC
1003 FORMAT(1H ,61X,14H(0= NO BARRIER    /
   1 62X,42H|1= RIGID BARRIER , FINITE VERT. DIM.        /
   2 10X,38HBARRIER OPTION                    INDB    =,I5,
   3  8X,42H-)2= ''      ''    ,INFINITE  ''    ''      /
   4 62X,42H|3= DEFORM. ''     , FINITE  ''    ''       /
   5 62X,42H(4=    ''     ''   ,INFINITE  ''    ''      /
   6 10X,38HBARRIER INTEGRATION INCR.         DELTB   =,F10.5,2X,A4  )
    IF(MODE.EQ.0) WRITE(6,1008) EBAR,EM,AAA,HMAX,HMIN,BET
1008 FORMAT(1H0,9X,34HARGUMENTS FOR MODE 0 INTEGRATION : /
   A        8X,6(2X,F12.3)  )
    WRITE(6,1004) XCOP,DINCH,UO,DIPS ,YCOP,DINCH,VO,DIPS,
   A              ZCOP,DINCH,WO,DIPS
1004 FORMAT(1H0,//,52X,38HI N I T I A L   C O N D I T I O N S   //
   1 40X, 8HXCOP    =,F8.2,3X,2A4,39X,6HUO    =,F8.2,3X,2A4      /
   2 10X,38HSPRUNG MASS C.G. POSITION        YCOP    =,F8.2,3X,2A4,
   3  7X,38HSPRUNG MASS LINEAR VELOCITY      VO      =,F8.2,3X,2A4  /
   4 40X, 8HZCOP    =,F8.2,3X,2A4,39X,6HWO    =,F8.2,3X,2A4        )
    WRITE(6,1005) PHIO,DEG,PO,DPS,THETAO,DEG,QO,DPS,
   1              PSIO,DEG,RO,DPS
1005 FORMAT(1H ,
   1 39X, 8HPHIO    =,F8.2,3X,2A4,39X,6HPO    =,F8.2,3X,2A4      /
   2 10X,38HSPRUNG MASS ORIENTATION          THETAO =,F8.2,3X,2A4 ,
   3  7X,38HSPRUNG MASS ANGULAR VELOCITY     QO      =,F8.2,3X,2A4 /
   4 40X, 8HPSIO    = F8.2,3X,2A4,39X,6HRO    =,F8.2,3X,2A4      )
    IF(ISUS.EQ.2) GO TO 101
    UMP1 = UD2
    TD1(1) = DINCH(1)
    TD1(2) = DINCH(2)
    TD2(1) = DIPS(1)
    TD2(2) = DIPS(2)
    UMP = DEL20
    UMV = DEL20D
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      GO TO 102                                                           IDOT1520
  101 UMP1 = UPF                                                          IDOT1530
      TD1(1) = DEG(1)                                                     IDOT1540
      TD1(2) = DEG(2)                                                     IDOT1550
      TD2(1) = DPS(1)                                                     IDOT1560
      TD2(2) = DPS(2)                                                     IDOT1570
      UMP = PHIFO                                                         IDOT1580
      UMV = PHIFOD                                                        IDOT1590
  102 WRITE(6,1006) DEL10,DINCH,DEL10D,DIPS,UMP1,UDE,UMP,TD1,UMP1,UVE,    IDOT1600
     1             UMV,TD2                                                IDOT1610
 1006 FORMAT(1H0,39X,8HDEL10  =,F8.2,3X,2A4,37X,8HDEL10D =,F8.2,3X,2A4/   IDOT1620
     1 10X,30HUNSPRUNG MASS POSITIONS        ,2A4,F8.2,3X,2A4,            IDOT1630
     2  7X,30HUNSPRUNG MASS VELOCITIES       ,2A4,F8.2,3X,2A4    )        IDOT1640
      IF(ISUS.EQ.1) GO TO 103                                             IDOT1650
      UMP1 = UPR                                                          IDOT1660
      TD1(1) = DEG(1)                                                     IDOT1670
      TD1(2) = DEG(2)                                                     IDOT1680
      TD2(1) = DPS(1)                                                     IDOT1690
      TD2(2) = DPS(2)                                                     IDOT1700
      UMP = PHIRO                                                         IDOT1710
      UMV = PHIROD                                                        IDOT1720
      GO TO 104                                                           IDOT1730
  103 UMP1 = UD4                                                          IDOT1740
      TD1(1) = DINCH(1)                                                   IDOT1750
      TD1(2) = DINCH(2)                                                   IDOT1760
      TD2(1) = DIPS(1)                                                    IDOT1770
      TD2(2) = DIPS(2)                                                    IDOT1780
      UMP = DEL40                                                         IDOT1790
      UMV = DEL40D                                                        IDOT1800
  104 WRITE(6,1007) DEL30,DINCH,DEL30D,DIPS,UMP1,UDE,UMP,TD1,UMP1,UVE,    IDOT1810
     1             UMV,TD2,PSIFIO,DEG,PSIFDO,DPS                          IDOT1820
 1007 FORMAT(1H ,39X,8HDEL30  =,F8.2,3X,2A4,37X,8HDEL30D =,F8.2,3X,2A4/   IDOT1830
     1 40X,2A4,F8.2,3X,2A4,37X,2A4,F8.2,3X,2A4  /                         IDOT1840
     2 10X,38HSTEER ANGLE                       PSIFIO =,F8.2,3X,2A4,     IDOT1850
     3  7X,38HSTEER VELOCITY                    PSIFDO =,F8.2,3X,2A4    ) IDOT1860
      WRITE(6,1000) (HED(I),I=1,18),DADE(1),DADE(2),                      IDOT1870
     1     (VHED(I),I=1,10),(THED(I),I=1,10),(CHED(I),I=1,10),            IDOT1880
     2     (GHED(I),I=1,10),(SHED(I),I=1,10)                              IDOT1890
      WRITE(6,2001) XMS,PS2PI,     A,DINCH,                               IDOT1900
     1             XMUF,PS2PI,    B,DINCH,                                IDOT1910
     2             XMUR,PS2PI,    ZF,DINCH                                IDOT1920
 2001 FORMAT(1H0,                                                         IDOT1930
     1  9X,37HSPRUNG MASS                       XMS   =,F10.3,1X,3A4,     IDOT1940
     2  5X,32HFRONT WHEEL X LOCATION    A     =,    F10.3,1X,2A4  /       IDOT1950
     3 10X,37HFRONT UNSPRUNG MASS               XMUF  =,F10.3,1X,3A4,     IDOT1960
     4  5X,32HREAR WHEEL X LOCATION     B     =,    F10.3,1X,2A4  /       IDOT1970
     5 10X,37HREAR UNSPRUNG MASS                XMUR  =,F10.3,1X,3A4,     IDOT1980
     6  5X,32HFRONT WHEEL Z LOCATION    ZF    =,    F10.3,1X,2A4  )       IDOT1990
      TD1(1) = TNU2(1)                                                    IDOT2000
      TD1(2) = TNU2(2)                                                    IDOT2010
      IF(ISUS.EQ.2) GO TO 201                                             IDOT2020
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      GO TO 202
  201 TD1(1) = DINCH(1)
      TD1(2) = DINCH(2)
  202 CONTINUE
      WRITE(6,2002) XIX, PS2I,      ZR   ,DINCH,
     1              XIY, PS2I,      TF   ,DINCH,
     2              XIZ, PS2I,      TR   ,DINCH,
     3              XIXZ,PS2I,    RHOF,TD1
 2002 FORMAT(1H ,
     1  9X,37HX MOMENT OF INERTIA              XIX    =,F10.3,1X,3A4 ,
     2  5X,32HREAR WHEEL Z LOCATION      ZR    =,     F10.3,1X,2A4 /
     3 10X,37HY MOMENT OF INERTIA              XIY    =,F10.3,1X,3A4 ,
     4  5X,32HFRONT WHEEL TRACK          TF    =,     F10.3,1X,2A4 /
     5 10X,37HZ MOMENT OF INERTIA              XIZ    =,F10.3,1X,3A4 ,
     6  5X,32HREAR WHEEL TRACK           TR    =,     F10.3,1X,2A4 /
     7 10X,37HXZ PRODUCT OF INERTIA            XIXZ   =,F10.3,1X,3A4 ,
     8  5X,32HFRONT ROLL AXIS            RHOF  =,     F10.3,1X,2A4 )
      DO 203 K=1,3
      T3D1(K) = TNU3(K)
  203 T3D2(K) = TNU3(K)
      DO 204 K=1,2
      TD1(K) = TNU2(K)
      TD2(K) = TNU2(K)
  204 TD3(K) = TNU2(K)
      IF(ISUS.EQ.1) GO TO 206
      DO 205 K=1,2
      T3D2(K) = PS2I(K)
      TD1(K) = DINCH(K)
  205 TD3(K) = DINCH(K)
      T3D2(3) = PS2I(3)
  206 IF(ISUS.NE.2) GO TO 208
      DO 207 K=1,2
      T3D1(K) = PS2I(K)
  207 TD2(K) = DINCH(K)
      T3D1(3) = PS2I(3)
  208 WRITE(6,2003) XIF, T3D1, RHO, TD1,
     1              XIR, T3D2, TSF, TD2,
     2              G    ,DIPS2,  TS,TD3
 2003 FORMAT(1H ,
     1  9X,37HFRONT AXLE MOMENT OF INERTIA  XIF    =,F10.3,1X,3A4 ,
     2  5X,32HREAR ROLL AXIS             RHO   =,     F10.3,1X,2A4 /
     3 10X,37HREAR AXLE MOMENT OF INERTIA   XIR    =,F10.3,1X,3A4 ,
     4  5X,32HFRONT SPRING TRACK         TSF   =,     F10.3,1X,2A4 /
     5 10X,37HGRAVITY                       G      =,F10.3,1X,3A4 ,
     6  5X,32HREAR SPRING TRACK          TS    =,     F10.3,1X,2A4 )
      DO 209 K=1,3
      T3D1(K) = TNU3(K)
      T3D2(K) = TNU3(K)
      IF(K.EQ.3) GO TO 209
      TD1(K) = TNU2(K)
      TD2(K) = TNU2(K)
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      TD3(K) = TNU2(K)                                                  IDOT2540
  209 CONTINUE                                                          IDOT2550
      IF(ISUS.EQ.1) GO TO 211                                           IDOT2560
      TD1(1) = RAPRA(1)                                                 IDOT2570
      TD1(2) = RAPRA(2)                                                 IDOT2580
      GO TO 213                                                         IDOT2590
  211 DO 212 K=1,3                                                      IDOT2600
      T3D1(K) = RPI2(K)                                                 IDOT2610
      T3D2(K) = RPI3(K)                                                 IDOT2620
      IF(K.EQ.3) GO TO 212                                              IDOT2630
      TD2(K) = RADS(K)                                                  IDOT2640
      TD3(K) = RPI(K)                                                   IDOT2650
  212 CONTINUE                                                          IDOT2660
  213 WRITE(6,2004) X1,       DINCH,    RF,       PIPR,                 IDOT2670
     5              Y1,       DINCH,    RR,       PIPR,                 IDOT2680
     2              Z1,       DINCH,    AKRS,     TD1,                  IDOT2690
     3              X2,       DINCH,    AKDS,     TD2,                  IDOT2700
     4              Y2,       DINCH,    AKDS1,    TD3,                  IDOT2710
     5              Z2,       DINCH,    AKDS2,    T3D1,                 IDOT2720
     6                                  AKDS3,    T3D2                  IDOT2730
 2004 FORMAT(1H0,39X,7HX1    = ,F10.2,1X,2A4  ,                         IDOT2740
     1  9X,32HFRONT AUX ROLL STIFFNESS  RF   =,F10.2,1X,3A4 /           IDOT2750
     2 10X,37HACCELEROMETER 1 POSITION      Y1    =,F10.2,1X,2A4 ,      IDOT2760
     3  9X,32HREAR AUX ROLL STIFFNESS   RR   =,     F10.2,1X,3A4 /      IDOT2770
     4 40X,7HZ1    =,F10.2,1X,2A4 ,                                     IDOT2780
     5  9X,32HREAR ROLL-STEER COEF.     AKRS =,     F10.4,1X,2A4 /      IDOT2790
     6 40X,7HX2    =,F10.2,1X,2A4 ,35X,6HAKDS =,F10.3,1X,2A4      /     IDOT2800
     7 10X,37HACCELEROMETER 2 POSITION      Y2    =,F10.2,1X,2A4 ,      IDOT2810
     8  9X,32HREAR DEFL-STEER COEFS.    AKDS1=,     F10.3,1X,2A4 /      IDOT2820
     9 40X,7HZ2    =,F10.2,1X,2A4,35X,6HAKDS2=,F10.3,1X,3A4       /     IDOT2830
     A101X,6HAKDS3=,F10.3,1X,3A4  )                                     IDOT2840
      WRITE(6,2005) XIPS,PS2I,CPSP,PDI,EPSPS,RAPS,AKPS,PIPR,            IDOT2850
     1              OMGPS,RADS,XPS,DINCH                                IDOT2860
 2005 FORMAT(1H0,15X,29HS T E E R I N G   S Y S T E M      /            IDOT2870
     1 10X,31HMOMENT OF INERTIA         XIPS  =,F10.3,1X,3A4 /          IDOT2880
     2 10X,31HCOULOMB FRICTION TORQUE CPSP  =,F10.3,1X,2A4 /            IDOT2890
     3 10X,31HFRICTION LAG              EPSP  =,F10.3,1X,2A4 /          IDOT2900
     4 10X,31HANGULAR STOP RATE         AKPS  =,F10.3,1X,3A4 /          IDOT2910
     5 10X,31HANGULAR STOP POSITION     OMGPS =,F10.3,1X,2A4 /          IDOT2920
     6 10X,31HPNEUMATIC TRAIL           XPS   =,F10.3,1X,2A4 )          IDOT2930
      WRITE(6,2006) AKF,      PPI,      AKR,      PPI,                  IDOT2940
     1              AKFC,     PPI,      AKRC,     PPI,                  IDOT2950
     2              AKFCP,    PPI3,     AKRCP,    PPI3                  IDOT2960
 2006 FORMAT(1H0,36X,16HFRONT SUSPENSION,20X,15HREAR SUSPENSION  //     IDOT2970
     1 10X,41HSUSPENSION RATE                      AKF    =,F10.3,1X,2A4,  IDOT2980
     2  9X,8HAKR    =,F10.3,1X,2A4  /                                   IDOT2990
     3 10X,41HCOMPRESSION STOP COEFS.              AKFC   =,F10.3,1X,2A4,  IDOT3000
     4  9X,8HAKRC   =,F10.3,1X,2A4  /                                   IDOT3010
     5 43X,8HAKFCP  =,F10.3,1X,2A4,9X,8HAKRCP  =,F10.3,1X,2A4    )      IDOT3020
      WRITE(6,2007) AKFE,     PPI,      AKRE,     PPI,                  IDOT3030
     1              AKFEP,    PPI3,     AKREP,    PPI3,                 IDOT3040
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   2               OMEGFC,   DINCH,    OMEGRC,   DINCH,                IDOT3050
   3               OMEGFE,   DINCH,    OMEGRE,   DINCH                 IDOT3060
2007 FORMAT(1H ,                                                       IDOT3070
   1  9X,41HEXTENSION STOP COEFS.              AKFE   =,F10.3,1X,2A4,  IDOT3080
   2  9X, 8HAKRE   =,F10.3,1X,2A4  /                                   IDOT3090
   3 43X, 8HAKFEP  =,F10.3,1X,2A4,9X,8HAKREP  =,F10.3,1X,2A4  /        IDOT3100
   4 10X,41HCOMPRESSION STOP LOCATION          OMEGFC =,F10.3,1X,2A4,  IDOT3110
   5  9X, 8HOMEGRC =,F10.3,1X,2A4  /                                   IDOT3120
   6 10X,41HEXTENSION STOP LOCATION            OMEGFE =,F10.3,1X,2A4,  IDOT3130
   7  9X, 8HOMEGRE =,F10.3,1X,2A4  )                                   IDOT3140
     WRITE(6,2008) XLAMF,                 XLAMR,                       IDOT3150
   1               CF,       PSPI,     CR,       PSPI,                 IDOT3160
   2               CFP,      PD,       CRP,      PD,                   IDOT3170
   3               EPSF,     DIPS,     EPSR,     DIPS                  IDOT3180
2008 FORMAT(1H ,                                                       IDOT3190
   1  9X,41HSTOP ENERGY DISSIPATION FACTOR     XLAMF  =,F10.3,         IDOT3200
   2 18X, 8HXLAMR  =,F10.3  /                                          IDOT3210
   3 10X,41HVISCOUS DAMPING COEF.              CF     =,F10.3,1X,3A4,  IDOT3220
   4  5X, 8HCR     =,F10.3,1X,3A4  /                                   IDOT3230
   5 10X,41HCOULOMB FRICTION                   CFP    =,F10.3,1X,1A4,  IDOT3240
   6 13X, 8HCRP    =,F10.3,1X,1A4  /                                   IDOT3250
   7 10X,41HFRICTION LAG                       EPSF   =,F10.3,1X,2A4,  IDOT3260
   8  9X, 8HEPSR   =,F10.3,1X,2A4  )                                   IDOT3270
     IF(ISUS.EQ.2.AND.TINCR.EQ.0.0) GO TO 304                          IDOT3280
     WRITE(6,1000) (HED(I),I=1,18),DADE(1),DADE(2),                    IDOT3290
   1      (VHED(I),I=1,10),(THED(I),I=1,10),(CHED(I),I=1,10),          IDOT3300
   2      (GHED(I),I=1,10),(SHED(I),I=1,10)                            IDOT3310
     IF(ISUS.EQ.2) GO TO 301                                           IDOT3320
     DO 306 K=1,2                                                      IDOT3330
     TD1(K) = DINCH(K)                                                 IDOT3340
 306 TD2(K) = DEG(K)                                                   IDOT3350
     IF(ISUS.EQ.1) GO TO 308                                           IDOT3360
     DO 307 K=1,2                                                      IDOT3370
     TD1(K) = TNU2(K)                                                  IDOT3380
 307 TD2(K) = TNU2(K)                                                  IDOT3390
 308 WRITE(6,3001) DINCH,DEG,TD1,TD2,DINCH,DINCH,TD1,TD1               IDOT3400
3001 FORMAT(1H0,                                                       IDOT3410
   A 10X,18HFRONT WHEEL CAMBER, 8X,17HREAR WHEEL CAMBER,               IDOT3420
   B  6X,23HFRONT HALF-TRACK CHANGE, 4X,22HREAR HALF-TRACK CHANGE  /   IDOT3430
   C 18X,2HVS,24X,2HVS,24X,2HVS,24X,2HVS  /                            IDOT3440
   D  9X,21HSUSPENSION DEFLECTION, 5X,21HSUSPENSION DEFLECTION,        IDOT3450
   E  5X,21HSUSPENSION DEFLECTION, 5X,21HSUSPENSION DEFLECTION    //   IDOT3460
   F 12X,15HDELTAF     PHIC,11X,16HDELTAR      PHIRC ,                 IDOT3470
   G 10X,15HDELTAF     DTHF,11X,15HDELTAR      DTHR  /                 IDOT3480
   H 12X,2A4,2X,2A4,8X,2A4,2X,2A4,8X,2A4,2X,2A4,8X,2A4,2X,2A4      )   IDOT3490
     Y = DELB                                                          IDOT3500
     DO 302 I=1,NDEL                                                   IDOT3510
     TTARG(I) = Y                                                      IDOT3520
     Y = Y+DDEL                                                        IDOT3530
 302 CONTINUE                                                          IDOT3540
     WRITE(6,3002) (TTARG(I),PHIC(I),TTARG(I),PHIRC(I),                IDOT3550
```

```
     1                  TTARG(I),DTHF(I),TTARG(I),DTHR(I),I=1,NDEL)
 3002 FORMAT(1H0,4(8X,F8.2,2X,F8.2)/(1X,4(8X,F8.2,2X,F8.2))       )
  301 CONTINUE
      NTPR = 0
      TTARG(1) = 0.0
      IF(TINCR.EQ.0.0) GO TO 304
      NTPR = (TE-TB)/TINCR + 1.5
      Y = TB
      DO 305 I=1,NTPR
      TTARG(I) = Y
      Y = Y+TINCR
  305 CONTINUE
      WRITE(6,3003)
 3003 FORMAT(1H0,//56X,21HDRIVER CONTROL TABLES  //
     1 4(32H      T      PSIF      TQF      TQR )      /
     2 4(32H     SEC      DEG    LB-FT    LB-FT)      /)
C        NTPR4 IS NUMBER OF LINES FOR TABLES IN FOUR GROUPS PER LINE
      NNADD = 0
      IF((MOD(NTPR,4)).NE.0) NNADD=1
      NTPR4 = NTPR/4 + NNADD
      NTPR43 = 3*NTPR4
      DO 303 J=1,NTPR4
      I1 = J
      I4 = MIN0(NTPR ,I1+NTPR43)
      WRITE(6,3004)((TTARG(II),PSIF(II),TQF(II),TQR(II)),II=I1,I4,NTPR4)
 3004 FORMAT(1X,4(F8.3,F8.3,F8.1,F8.1)  )
  303 CONTINUE
  304 CONTINUE
C
      WRITE(6,1000) (HED(I),I=1,18),DADE(1),DADE(2),
     1      (VHED(I),I=1,10),(THED(I),I=1,10),(CHED(I),I=1,10),
     2      (GHED(I),I=1,10),(SHED(I),I=1,10)
      WRITE(6,4001)
 4001 FORMAT(1H0,60X,17HT I R E   D A T A   /
     A 54X,2HRF,10X,2HLF,10X,2HRR,10X,2HLR  )
      WRITE(6,4002) AKT,PPI,SIGT,DINCH,XLAMT,A0,A1,A2,A3,A4,OMEGT,
     A              RW,DINCH,AMU
 4002 FORMAT(1H0,
     A  9X,39HTIRE LINEAR SPRING RATE           AKT    =,4(F10.3,2X),2A4 /
     B 10X,39HDEFL. FOR INCREASED RATE          SIGT   =,4(F10.3,2X),2A4 /
     C 10X,39HSPRING RATE INCREASING FACTOR     XLAMT  =,4(F10.3,2X)     /
     D 41X, 8HA0      =,4(F10.3,2X)  /
     E 41X, 8HA1      =,4(F10.3,2X)  /
     F 10X,39HSIDE FORCE COEFFICIENTS           A2     =,4(F10.3,2X)     /
     G 41X, 8HA3      =,4(F10.3,2X)  /
     H 41X, 8HA4      =,4(F10.3,2X)  /
     I 10X,39HTIRE OVERLOAD FACTOR              OMEGT  =,4(F10.3,2X)     /
     J 10X,39HTIRE UNDEFLECTED RADIUS           RW     =,4(F10.3,2X),2A4 /
     K 10X,39HTIRE / GROUND FRICTION COEF.      AMU    =,4(F10.3,2X)     )
      IF( IAPFR(1) .EQ.0 .AND. IAPFR(2) .EQ.0) GO TO 400
      WRITE(6,4004)
```

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4004 FORMAT(1H0,8X,48HANTI-PITCH TABLES FOR CIRCUMFERENTIAL TIRE FORCE IDOT4070
   1     // 9X,11HFRONT WHEEL,5X,3HAPF,5X,10HREAR WHEEL,5X,3HAPR /     IDOT4080
   2     9X,11HDEFL. - IN.,3X,8HLB/LB-FT,5X,10HDEFL.- IN.,              IDOT4090
   3     3X,8HLB/LB-FT  / )                                             IDOT4100
     FDEF = DAPFB                                                       IDOT4110
     RDEF = DAPRB                                                       IDOT4120
     MAP = NAPF                                                         IDOT4130
     IF(NAPF.NE.NAPR) MAP = MINO(NAPF,NAPR)                             IDOT4140
     IF(NAPF.EQ.0) GO TO 402                                            IDOT4150
     IF(NAPR.EQ.0) GO TO 406                                            IDOT4160
     DO 401 I=1,MAP                                                     IDOT4170
     WRITE(6,4005) FDEF,APF(I),RDEF,APR(I)                              IDOT4180
4005 FORMAT(5X,4(5X,F8.4))                                              IDOT4190
     FDEF = FDEF+DDAPF                                                  IDOT4200
 401 RDEF = RDEF+DDAPR                                                  IDOT4210
     IF(NAPF.EQ.NAPR) GO TO 404                                         IDOT4220
     IF(NAPR.GT.NAPF) GO TO 402                                         IDOT4230
 406 MAP1 = MAP+1                                                       IDOT4240
     DO 403 I=MAP1,NAPF                                                 IDOT4250
     WRITE(6,4006) FDEF,APF(I)                                          IDOT4260
4006 FORMAT(5X,2(5X,F8.4))                                              IDOT4270
 403 FDEF = FDEF+DDAPF                                                  IDOT4280
     GO TO 404                                                          IDOT4290
 402 MAP1 = MAP+1                                                       IDOT4300
     DO 405 I=MAP1,NAPR                                                 IDOT4310
     WRITE(6,4007) RDEF,APR(I)                                          IDOT4320
4007 FORMAT(31X,2(5X,F8.4))                                             IDOT4330
 405 RDEF = RDEF+DDAPR                                                  IDOT4340
     GO TO 404                                                          IDOT4350
 400 WRITE(6,4008)                                                      IDOT4360
4008 FORMAT(21HONO ANTI-PITCH TABLES)                                   IDOT4370
 404 CONTINUE                                                           IDOT4380
     IF(INDCRB.NE.1) GO TO 702                                          IDOT4390
     WRITE(6,1000) (HED(I),I=1,18),DADE(1),DADE(2),                     IDOT4400
   1   (VHED(I),I=1,10),(THED(I),I=1,10),(CHED(I),I=1,10),              IDOT4410
   2    (GHED(I),I=1,10),(SHED(I),I=1,10)                               IDOT4420
     WRITE(6,6010)                                                      IDOT4430
6010 FORMAT(1H0,22X,17HC U R B   D A T A    //                          IDOT4440
   A 10X,54HCURB SLOPE CHANGE     ELEVATION AT      CURB FACE ANGLE  /  IDOT4450
   B 10X,34H LATERAL POSITION     SLOPE CHANGE   /                      IDOT4460
   C 18X,6HINCHES,11X,6HINCHES,11X,7HDEGREES      //   )                IDOT4470
     WRITE(6,6011) YC1P,                 PHIC1,                         IDOT4480
   A               YC2P,     ZC2P,       PHIC2,                         IDOT4490
   B               YC3P,     ZC3P,       PHIC3,                         IDOT4500
   C               YC4P,     ZC4P,       PHIC4,                         IDOT4510
   D               YC5P,     ZC5P,       PHIC5,                         IDOT4520
   E               YC6P,     ZC6P,       PHIC6,                         IDOT4530
   F               NCRBSL,   AMUC                                       IDOT4540
6011 FORMAT(1H ,                                                        IDOT4550
   A 11X,6HYC1P =,F9.2,23X,7HPHIC1 =,F9.2,  /                           IDOT4560
   B 12X,6HYC2P =,F9.2,3X,6HZC2P =,F9.2,5X,7HPHIC2 =,F9.2,    /         IDOT4570
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```
     C 12X,6HYC3P =,F9.2,3X,6HZC3P =,F9.2,5X,7HPHIC3 =,F9.2,     /
     D 12X,6HYC4P =,F9.2,3X,6HZC4P =,F9.2,5X,7HPHIC4 =,F9.2,     /
     E 12X,6HYC5P =,F9.2,3X,6HZC5P =,F9.2,5X,7HPHIC5 =,F9.2,     /
     F 12X,6HYC6P =,F9.2,3X,6HZC6P =,F9.2,5X,7HPHIC6 =,F9.2,     /
     G 12X,8HNCRBSL =,I4   /
     F 10X,43HCURB FRICTION COEFFICIENT FACTOR    AMUC  =,F8.3        )
      WRITE(6,7001) RWHJB,RWHJE,DRWHJ
 7001 FORMAT(37H0WHEEL RADIUS-RADIAL SPRING FOR TABLE  /17H RWHJB(BEGIN)
     1   =,F8.3,7H INCHES / 17H RWHJE(END)      =,F8.3,5H   '' /,
     2 17H DRWHJ(INCRE.)  =,F8.3,5H   '' )
      NFJP = 0
      IF(DRWHJ.EQ.0.0) GO TO 702
      NFJP = (RWHJE-RWHJB)/DRWHJ + 1.2
      IF(NFJP.LE.0) GO TO 702
      Y = RWHJB
      DO 701 I=1,NFJP
      TTARG(I) = Y
      Y = Y + DRWHJ
  701 CONTINUE
      WRITE(6,7002)
 7002 FORMAT(//1H ,3X,5HRW-HJ,6X,4HFJP.,6X,4HFJP.,6X,4HFJP.,6X,4HFJP. /
     A         5X,3HIN.,7X,4HLBS.,6X,4HLBS.,6X,4HLBS.,6X,4HLBS.    /
     B         16X,2HRF,8X,2HLF,8X,2HRR,8X,2HLR    /  )
      DO 703 J=1,NFJP
      WRITE(6,7003) TTARG(J),(FJP(J,II),II=1,4)
 7003 FORMAT(1H ,G9.3,4G10.3)
  703 CONTINUE
  702 CONTINUE
      IF(INDB.EQ.0) GO TO 501
 5001 FORMAT(1H0,36X,31HSPRUNG MASS-BARRIER IMPACT DATA  //
     A      6X,18HBARRIER DIMENSIONS ,56X,24HBARRIER LOAD DEFL. COEF.  )
      WRITE(6,5002) YBPO,AKV,SIGR(1),DELYBP,SET,SIGR(2),
     A               ZBTP,CONS,SIGR(3),ZBBP,AMUB,SIGR(4),
     B               EPSV,SIGR(5)
 5002 FORMAT(1H0,3X,9H(YB')0 = ,F10.3,7H INCHES,6X,12HKV          = ,F10.3
     A      ,13H LB/IN**3    ,9X,11HSIGMAR 0 = ,F10.4   /
     B       4X,9HDELYB' = ,F10.3,7H  ''   ,6X,12HSET         = ,F10.3 ,
     C       13H DEFL. RATIO ,9X,11HSIGMAR 1 = ,F10.4   /
     D       4X,9HZBT'   = ,F10.3,7H  ''   ,6X,12HCONS        = ,F10.3,
     E       13H ENERGY RATIO,9X,11HSIGMAR 2 = ,F10.4   /
     F       4X,9HZBB'   = ,F10.3,7H  ''   ,6X,12HMUB         = ,F10.3,
     G       13H             ,9X,11HSIGMAR 3 = ,F10.4   /
     H       4X,18HVEHICLE DIMENSIONS,12X,12HEPSILON V = ,F10.3,
     I       13H IN/SEC      ,9X,11HSIGMAR 4 = ,F10.4   )
      WRITE(6,5003) XVF,EPSB,SIGR(6),XVR,       SIGR(7),
     1               YV,SIGR(8),ZVT,SIGR(9),ZVB,SIGR(10),SIGR(11)
 5003 FORMAT(1H ,3X,9HXVF     = ,F10.3,7H INCHES,6X,12HEPSILON B = ,F10.3
     A      ,3H LB,18X,11HSIGMAR 5 = ,F10.4   /
     B       4X,9HXVR     = ,F10.3,7H  ''   ,  47X,
     C                               3X,11HSIGMAR 6 = ,F10.4   /
     D       4X,9HYV      = ,F10.3,7H  ''   ,50X,11HSIGMAR 7 = ,F10.4  /
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     E       4X,9HZVT     = ,F10.3,7H  ''    ,50X,11HSIGMAR 8 = ,F10.4  / IDOT5090
     F       4X,9HZVB     = ,F10.3,7H  ''    ,50X,11HSIGMAR 9 = ,F10.4  / IDOT5100
     G       80X,11HSIGMAR10 = ,F10.4    )                                IDOT5110
      WRITE(6,5004) (I,XSTIO(I),YSTIO(I),ZSTIO(I),AKST(I),I=1,3)          IDOT5120
 5004 FORMAT(1H0,18X,27HSPRUNG MASS HARD POINT DATA    //                 IDOT5130
     A 19X,37HLOCATION IN VEH. COORDS.    STIFFNESS    /                  IDOT5140
     B  9X,45HPOINT      XSTIO     YSTIO     ZSTIO       AKST  /          IDOT5150
     C  9X,44H NO.        IN.        IN.        IN.     LB/IN  //         IDOT5160
     D  (9X,I2,4X,F8.2,2X,F8.2,2X,F8.2,2X,F8.2   )  )                     IDOT5170
  501 CONTINUE                                                            IDOT5180
      IF(NZTAB.EQ.0) GO TO 700                                            IDOT5190
      DO 601 I=1,50                                                       IDOT5200
  601 TTARG(I) = 0.0                                                      IDOT5210
      DO 602 I=1,10                                                       IDOT5220
  602 NTARG(I) = 0                                                        IDOT5230
      DO 603 I=1,NZTAB                                                    IDOT5240
      TTARG(I) =        XB(I)                                             IDOT5250
      TTARG(5 + I)= XE(I)                                                 IDOT5260
      TTARG(10 + I) = XINCR(I)                                            IDOT5270
      TTARG(15 + I) = YB(I)                                               IDOT5280
      TTARG(20 + I) = YE(I)                                               IDOT5290
      TTARG(25 + I) = YINCR(I)                                            IDOT5300
      TTARG(30 + I) = AMUG(I)                                             IDOT5310
      NTARG(I)       = NBX(I)                                             IDOT5320
      NTARG(5 + I) = NBY(I)                                               IDOT5330
  603 CONTINUE                                                            IDOT5340
      WRITE(6,1000) (HED(I),I=1,18),DADE(1),DADE(2),                      IDOT5350
     1     (VHED(I),I=1,10),(THED(I),I=1,10),(CHED(I),I=1,10),            IDOT5360
     2     (GHED(I),I=1,10),(SHED(I),I=1,10)                              IDOT5370
      WRITE(6,6001)                                                       IDOT5380
 6001 FORMAT(//1H ,26X,25HTERRAIN TABLE ARGUMENTS        )                IDOT5390
      WRITE(6,6002)  (TTARG(I),I=1,5),                                    IDOT5400
     1               (TTARG(I),I=6,10),                                   IDOT5410
     2               (TTARG(I),I=11,14),ZERO,                             IDOT5420
     3               (TTARG(I),I=16,20),                                  IDOT5430
     4               (TTARG(I),I=21,25),                                  IDOT5440
     5               (TTARG(I),I=26,29),ZERO,                             IDOT5450
     6               (NTARG(I),I=1,5),                                    IDOT5460
     7               (NTARG(I),I=6,10),                                   IDOT5470
     8               (TTARG(I),I=31,35),                                  IDOT5480
     9                NZTAB                                               IDOT5490
 6002 FORMAT(1H0,25X,11H XB(BEGIN)=,5F12.3,7H INCHES   /                  IDOT5500
     A          26X,11H XE(END)  =,5F12.3,5H   ''      /                  IDOT5510
     B          26X,11H X(INCR)  =,5F12.3,5H   ''      /                  IDOT5520
     C          26X,11H YB(BEGIN)=,5F12.3,5H   ''      /                  IDOT5530
     D          26X,11H YE(END)  =,5F12.3,5H   ''      /                  IDOT5540
     E          26X,11H Y(INCR)  =,5F12.3,5H   ''      /                  IDOT5550
     F         25X,12HNO.X BOUNDS=,I8,4I12             /                  IDOT5560
     G         25X,12HNO.Y BOUNDS=,I8,4I12             /                  IDOT5570
     H          26X,11H AMUG     =,5F12.3              /                  IDOT5580
     I          25X,18HNO.TERRAIN TABLES=,I4           )                  IDOT5590
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```
      IF(NZ5.EQ.0) GO TO 600
      WRITE(6,1000) (HED(I),I=1,18),DADE(1),DADE(2),
     1     (VHED(I),I=1,10),(THED(I),I=1,10),(CHED(I),I=1,10),
     2     (GHED(I),I=1,10),(SHED(I),I=1,10)
      NX5 = NX(NZTAB)
      NY5 = NY(NZTAB)
      WRITE(6,6004) NX5, (XXZGP5(I),I=1,NX5)
 6004 FORMAT(66H0 ARGUMENTS FOR TERRAIN TABLE WITH VARYING INCREMENTS (L
     1AST TABLE) /10H NO.OF X =, I3,2X,9H, X(ZGP)=, 12F9.3/24X,9F9.3)
      WRITE(6,6003) NY5, (YYZGP5(I),I=1,NY5)
 6003 FORMAT(10H0NO.OF Y =, I3,2X,9H, Y(ZGP)=,12F9.3/24X, 9F9.3)
C
  600 IF(NZTAB) 604,700,604
  604 WRITE(6,1000) (HED(I),I=1,18),DADE(1),DADE(2),
     1     (VHED(I),I=1,10),(THED(I),I=1,10),(CHED(I),I=1,10),
     2     (GHED(I),I=1,10),(SHED(I),I=1,10)
      LINES =3
      DO 614 I=1,NZTAB
      NNBX = NBX(I)
      NNBY = NBY(I)
      NNX = NX(I)
      NNY = NY(I)
      LINES = LINES + 9 + (NNY+1)*(NNX/7 + 2)
      IF(I.EQ.1) GO TO 606
      IF(LINES .LT.55) GO TO 606
      WRITE(6,1000) (HED(N),N=1,18),DADE(1),DADE(2),
     1     (VHED(N),N=1,10),(THED(N),N=1,10),(CHED(N),N=1,10),
     2     (GHED(N),N=1,10),(SHED(N),N=1,10)
      LINES =3
  606 WRITE(6,6005) I,AMUG(I),(XBDRY(J,I),J=1,NNBX)
 6005 FORMAT(19H0 TERRAIN TABLE NO. ,I3,  20X, 6H AMUG=, F13.5//
     X 1X,16H  X  BOUNDARIES=,4F13.5)
      WRITE(6,6006) (PSBDRO(J,I),J=1,NNBX)
 6006 FORMAT(1X,16H PSI BOUNDARIES=,4F13.5)
      WRITE(6,6007) (YBDRY(J,I),J=1,NNBY)
 6007 FORMAT(1X,16H  Y  BOUNDARIES=,2F13.5)
      IF( I.EQ.NZTAB .AND. NZ5.NE.0) GO TO 607
      ANAME = CON1
      Y= XB(I)
      YYY = XINCR(I)
      DO 605 J=1,NNX
      TXARG(J) = Y
      Y = Y + YYY
  605 CONTINUE
      Y = YB(I)
      YYY = YINCR(I)
      DO 609 J=1,NNY
      TYARG(J) = Y
      Y = Y + YYY
  609 CONTINUE
      GO TO 610
```

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  607 ANAME = VARI
      DO 611 J=1,NNX
  611 TXARG(J) = XXZGP5(J)
      DO 612 J=1,NNY
  612 TYARG(J) = YYZGP5(J)
  610 WRITE(6,6008)ANAME,(TXARG(J),J=1,NNX)
 6008 FORMAT(1H0,A4,17H. INCREMENTS   X=,2X,7F13.5/26X,7F13.5/28X,7F13.5
     X )
      DO 613 II=1,NNY
      WRITE(6,6009) TYARG(II),(ZGP(JJ,II,I),JJ=1,NNX)
 6009 FORMAT(/2X,3H Y=,F13.5, 6X,7F13.5/26X,7F13.5/28X,7F13.5)
  613 CONTINUE
  614 CONTINUE
C
  700 CONTINUE
C
      CALL DRIVID
      WRITE(6,8000)
 8000 FORMAT (1H1)
      RETURN
      END
```

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      SUBROUTINE INITEQ                                                 INIT0010
C             HVOSM-VD2 VERSION                                         INIT0020
C             REVISED OCTOBER 1975   CALSPAN CORPORATION                INIT0030
      COMMON/INPT/PHIO,THETAO,PSIO,PO,QO,RO,XCOP,YCOP,ZCOP,UO,VO,WO,    INIT0040
     1          A,B,DEL10,DEL20,DEL30,PHIRO,DEL10D,DEL20D,DEL30D,       INIT0050
     2          PHIROD,TF,TR,ZF,ZR,RHO,AKRS,XMUR,                       INIT0060
     3          XMS,XMUF,XIX,XIY,XIZ,XIXZ,CF,AKF,XLAMF,OMEGF,CFP,EPSF,INIT0070
     4          RF,CR,AKR,XLAMR,OMEGR,CRP,EPSR,RR,TS,THMAX,DTCOMP,TO,   INIT0080
     5          T1,DTCMP1,DTPRNT,MODE,EBAR,EM,AAA,HMAX,HMIN,BET,G,      INIT0090
     6          HED(36),DADE(3),XIR,X1,Y1,Z1,X2,Y2,Z2,PHIC(50),DELB,    INIT0100
     7          DELE,DDEL,NDEL,PSIF(50),TQF(50),TQR(50),TB,TE,TINCR,    INIT0110
     8          NZTAB,NZ5,XBDRY(4,5),PSBDRY(4,5),YBDRY(2,5),NBX(5),     INIT0120
     9          NBY(5),NTBL1,NTBL2,NTBL3,ZGP(21,21,5)                   INIT0130
      COMMON/INPT/XB(5),XE(5),XINCR(5),NX(5),YB(5),YE(5),YINCR(5),NY(5),INIT0140
     1        XXZGP5(21),YYZGP5(21),AMUG(5),PSBDRO(4,5),UVWMIN,PQRMIN   INIT0150
      COMMON /COMP/SUMM,THETN,PHIN,PSIN,PI,RAD,GAM1,GAM2,GAM3,GAM4,GAM5,INIT0160
     1          GAM6,GAM7,GAM8,GAM9,THETT,PHIT,PSIT,ZRO,TRO2,           INIT0170
     2           TFO2,TIZ,RHO2,RHOMUR,AMUF,BMUR,ZPR,TM4,RHMR2,AO2APB,   INIT0180
     3           BO2APB,RFTF,TSO2,RRTS,BROMUR,XMUFO2,AXMFO2,XMTFO4,     INIT0190
     4           XIZR,RTR,RHMR2I,XIXP,XIZP,XIXZP,XIYZP,D1PD2,D1MD2,     INIT0200
     5           ZRD3,ZRD3R,ZFD3R,ZFD12,TIZ2,TG61,DD1P2,DD1M2,RPR,PHRPINIT0210
     6          ,TANTP,SPHTP,CPHTP,SECTP,SFXS,SFYS,SFZS,SNPS,SNTS,      INIT0220
     7           SNPSS,TPR,CAY,CBY,CGY,CAX,CBX,CGX,SFYU,SFXU,SFYUF,     INIT0230
     8           SFYUR,SFZU,COSTH,SINTH,COSPS,SINPS,COSPH,SINPH,ANG1,   INIT0240
     9           ANG2,CPHI,SPHI,CPSI,SPSI,P1,P7,P3,P4,P5,P6,TX,TY,TZ    INIT0250
      COMMON /COMP/TRH,DISTX,DISTY,DISTD,DISTS,D21,ZETA4,ZETA4D,ZETA3,  INIT0260
     1           ZETA3D,SFZ1,SNPU,SNTU,HCGH1,HCGH2,HCGH3,HCGH4,TERM1,   INIT0270
     2           TERM2,SNPSU,SNPR,HCBH1,HCBH2,HCBH3,HCBH4,HCAH1,HCAH2,INIT0280
     3           HCAH3,HCAH4,UQ,WP,UR,QR,VP,PR,P2,Q2,R2,VR,WQ,PQ,PHIR2INIT0290
     4          ,PHIRD2,RPHRD,GCTH,GSTH,GCTSP,GCTCP,XXX,YYY,IX,IY,XX1,INIT0300
     5           XX2,YY1,YY2,THG1,THG2,PHG1,PHG2,ZZ1,ZZ2,LLL            INIT0310
      DIMENSION HCAH(4),HCBH(4),HCGH(4)                                 INIT0320
      EQUIVALENCE (HCAH(1),HCAH1),(HCBH(1),HCBH1),(HCGH(1),HCGH1)       INIT0330
      COMMON /DIMV/X1P,X2P,X3P,X4P,Y1P,Y2P,Y3P,Y4P,Z1P,Z2P,Z3P,Z4P,PHI1,INIT0340
     1           PHI2,PHI3,PHI4,PSI1,PSI2,PSI3,PSI4,CAYW(4),CBYW(4),    INIT0350
     2           CGYW(4),ZPGI(4),THGI(4),PHGI(4),CPG(4),SPG(4),CTG(4),INIT0360
     3           STG(4),CAGZ(4),CBGZ(4),CGGZ(4),D1(4),D2(4),D3(4),      INIT0370
     4           XLM1(4),XLM2(4),XLM3(4),AMTX(3,3),CMTX(3,4),XGPP(4),   INIT0380
     5           YGPP(4),ZGPP(4),DMATX(10,11),DELTA(4),CAR(4),CBR(4),   INIT0390
     6           CGR(4),FR(4),HI(4),FC(4),TI(4),AX(4),BX(4),CX(4),      INIT0400
     7           CTXG(4),UG(4),STXG(4),AY(4),BY(4),CY(4),CPYG(4),       INIT0410
     8           SPYG(4),VG(4),PSIIP(4),PHICI(4),CAC(4),CBC(4),CGC(4),INIT0420
     9           FCXU(4),FCYU(4),FCZU(4),FS(4),CAXW(4),CBXW(4),CGXW(4)INIT0430
      COMMON /DIMV/AS(4),BS(4),CS(4),CAS(4),CBS(4),CGS(4),BETP(4),      INIT0440
     1           BETBR(4),FSXU(4),FSYU(4),FSZU(4),FRXU(4),FRYU(4),      INIT0450
     2           FRZU(4),FXU(4),FYU(4),FZU(4),SI(4),F1FI(2),F1RI(2),    INIT0460
     3           F2FI(2),F2RI(2),CAH(4),CBH(4),CGH(4)                   INIT0470
      DIMENSION XP(4),YP(4),ZP(4),PHII(4),PSII(4)                       INIT0480
      EQUIVALENCE (XP(1),X1P),(YP(1),Y1P),(ZP(1),Z1P),(PHII(1),PHI1),   INIT0490
```

```
1             (PSII(1),PSI1)
 COMMON /COMPN/ FRSP(4),FRCP(4),ICBHIT,JCBHIT,
1               DPSINT,TANPC1,TANPC2,PHIC1R,PHIC2R,AMUCMP,PHI1D,
2               PHI2D,LCB1(4),LCB2(4),IHIT,AJMTX(3,3),BMTX(3,3),
3               SFRX(4),SFRY(4),SFRZ(4),T1PSI,T2PSI,XMUGI(4)
 LOGICAL LCB1,LCB2
 COMMON /INSUS/ XIF,RHOF,TSF,PHIF0,PHIF0D,DEL40,DEL40D,ISUS,
1               AKDS,AKDS1,AKDS2,AKDS3,PHIRC(50),DTHF(50),DTHR(50),
2               NCAMF,NCAMR,NDTHF,NDTHR
 COMMON /TIRIN/ AKT(4),SIGT(4),XLAMT(4),A0(4),A1(4),A2(4),A3(4),
1               A4(4),OMEGT(4),AMU(4),RW(4),FJP(35,4),A234(4),
2               A12(4),OMT2A2(4),OMT2M1(4),A23(4),ITIR(4)
 DATA RPD/.01745329/
 RHF = 0.0
 RHR = 0.0
 IF(ISUS.NE.1) RHR = RHO
 IF(ISUS.EQ.2) RHF = RHOF
 CTHO = COS(THETAO*RPD)
 STHO = SIN(THETAO*RPD)
 SIR = XMS*A*G*CTHO/(A+B)
 SIF = XMS*G*CTHO-SIR
 DTF = (SIF/CTHO+XMUF*G)*0.5/AKT(1)
 DTR = (SIR/CTHO+XMUR*G)*0.5/AKT(3)
 SD1 = 0.5*(B*XMS*G/(A+B)-SIF)/AKF
 SD3 = 0.5*(A*XMS*G/(A+B)-SIR)/AKR
 HCG = -ZCOP
 ZF = (HCG+A*STHO-RW(1)+DTF)/CTHO-RHF-SD1
 ZR = (HCG-B*STHO-RW(3)+DTR)/CTHO-RHR-SD3
 FR(1) = AKT(1)*DTF
 FR(2) = FR(1)
 FR(3) = AKT(3)*DTR
 FR(4) = FR(3)
 HI(1) = RW(1)-DTF
 HI(2) = HI(1)
 HI(3) = RW(3)-DTR
 HI(4) = HI(3)
 RETURN
 END
```

```
      SUBROUTINE INPUT
C             HVOSM-RD2 VERSION
C             REVISED OCTOBER 1975   CALSPAN CORPORATION
      DIMENSION CARDIM(20),ICARD(300),DUM(18)
      DATA NBLKS/6/
      WRITE(6,1000)
 1000 FORMAT(1H1)
C          SET INPUT CARD COUNTER
      NC = 0
C        REWIND UNIT 2
      REWIND 2
C         READ A CARD
    1 READ(5,5000,END=999) (CARDIM(K),K=1,18),NSEQ,NCARD
 5000 FORMAT(18A4,2I4)
C        OUTPUT CARD IMAGE
      WRITE(2,2001) (CARDIM(K),K=1,18),NSEQ,NCARD
      WRITE(6,6000) (CARDIM(K),K=1,18),NSEQ,NCARD
 6000 FORMAT(1H ,18A4,2I4)
      IF(NCARD.GE.9999) GO TO 20
      IF(NCARD.LE.0) GO TO 90
      IF(NSEQ.GT.0) GO TO 1
      NC = NC+1
      ICARD(NC) = NCARD
      GO TO 1
   20 REWIND 2
C        TEST FOR AT LEAST ONE CARD OTHER THAN 9999
      IF(NC.LE.0) GO TO 91
C        SET COUNTER TO PROCESS ALL BLOCK NUMBERED CARDS
      IC = 1
C       DETERMINE CARD FORMAT AND TRANSFER TO PROPER CARD BLOCK
C        SUBROUTINE TO STORE DATA
   21 NBLK = ICARD(IC)/100
      NBCRD = ICARD(IC)-NBLK*100
C        FORMAT TEST
      IF(NBCRD.EQ.0) GO TO 22
C        NUMERIC INPUT
      READ(2,2000) (DUM(K),K=1,9),NSEQ,NCARD
 2000 FORMAT(9F8.0,2I4)
      GO TO 23
   22 CONTINUE
C        ALPHANUMERIC INPUT
      READ(2,2001) (DUM(K),K=1,18),NSEQ,NCARD
 2001 FORMAT(18A4,2I4)
C        BRANCH TO PROPER SUBROUTINE TO STORE INPUT
   23 IF(NBLK .LE.0) GO TO 92
      IF(NBLK.GT.NBLKS) GO TO 93
      GO TO(100,200,300,400,500,600),NBLK
C  PRINT ERROR MESSAGE HERE ?
  100 NERR = 0
```

```
      CALL BLK01(NBLK,NBCRD,NSEQ,NCARD,DUM,NERR)
C        TEST FOR ERROR
      IF(NERR.EQ.0) GO TO 30
      GO TO 94
  200 CALL BLK02(NBLK,NBCRD,NSEQ,NCARD,DUM,NERR)
      IF(NERR.EQ.0) GO TO 30
      GO TO 94
  300 NERR = 0
      CALL BLK03(NBLK,NBCRD,NSEQ,NCARD,DUM,NERR)
      IF(NERR.EQ.0) GO TO 30
      GO TO 94
  400 NERR = 0
      CALL BLK04(NBLK,NBCRD,NSEQ,NCARD,DUM,NERR)
      IF(NERR.EQ.0) GO TO 30
      GO TO 94
  500 NERR = 0
      CALL BLK05(NBLK,NBCRD,NSEQ,NCARD,DUM,NERR)
      IF(NERR.EQ.0) GO TO 30
      GO TO 94
  600 NERR = 0
      CALL BLK06(NBLK,NBCRD,NSEQ,NCARD,DUM,NERR)
      IF(NERR.EQ.0) GO TO 30
      GO TO 94
   30 CONTINUE
C        TEST IF ALL CARDS ARE READ
      IC = IC+1
      IF(IC.GT.NC) GO TO 40
C        GET NEXT CARD FROM UNIT 2
      GO TO 21
   40 CONTINUE
C        SEARCH FOR END OF DATA
      READ(2,2001) (DUM(K),K=1,18),NSEQ,NCARD
      IF(NCARD.NE.9999) GO TO 95
      GO TO 50
  999 WRITE(6,6001) NCARD
 6001 FORMAT(56H UNEXPECTED END OF FILE ENCOUNTERED IN STMT NO. 1 OF SUB
     1       34HROUTINE INPUT.  LAST CARD READ WAS   ,I4  )
      GO TO 49
   90 WRITE(6,6002)
 6002 FORMAT(56H A CARD NUMBERED LESS THAN OF EQUAL TO ZERO WAS ENCOUNTE
     1       50HRED IN SUBROUTINE INPUT.  CARD IMAGE PRINTED ABOVE   )
      GO TO 49
   91 WRITE(6,6003)
 6003 FORMAT(33H THE NUMBER OF CARDS READ IS ZERO    )
      GO TO 49
   92 WRITE(6,6004)
 6004 FORMAT(56H A BLOCK NUMBER OF LESS THAN OF EQUAL TO ZERO HAS BEEN O
     1       7HBTAINED    )
      GO TO 49
   93 WRITE(6,6005)
 6005 FORMAT(56H A BLOCK NUMBER LARGER THAN THE ALLOWED NUMBER HAS BEEN 
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   1        8HOBTAINED   )                                              INPT1010
    GO TO 49                                                            INPT1020
  94 WRITE(6,6006) NBLK,NBCRD,NSEQ,NCARD,NERR                           INPT1030
6006 FORMAT(56H AN ERROR HAS OCCURRED IN STORING INPUT VALUES IN ONE OFINPT1040
   1        23H THE BLKXX SUBROUTINES.      /                           INPT1050
   2        39H THE CALLING ARGUMENTS FROM INPUT ARE :   /              INPT1060
   3         7H NBLK =,I4,2X,7HNBCRD =,I4,2X,6HNSEQ =,I4,2X,7HNCARD =, INPT1070
   4         I4,2X,6HNERR =,I4     )                                    INPT1080
    GO TO 49                                                            INPT1090
  95 WRITE(6,6007)                                                      INPT1100
6007 FORMAT(56H AN EXPECTED 9999 CARD HAS NOT BEEN ENCOUNTERED AFTER STINPT1110
   1        20H MT NO. 40 IN INPUT.      )                              INPT1120
  49 STOP                                                               INPT1130
  50 RETURN                                                             INPT1140
     END                                                                INPT1150
```

```
      SUBROUTINE INTRPL(TABLE,XMIN,XMAX,DX,X,Y)
C               HVOSM-RD2 VERSION
C               REVISED OCTOBER 1975   CALSPAN CORPORATION
C     QUADRATIC INTERPOLATION SUBROUTINE INTRPL,ADDITIONAL ENTRY INTRPC
      DIMENSION TABLE(1)
      ENTRY INTRPC(TABLE,XMIN,XMAX,DX,X,Y,SLOPE)
    1 XLK = AMIN1(X,XMAX)
      XLK = AMAX1(XLK,XMIN)
      N1 = (XLK-XMIN)/DX+1.2
      N2 = N1+1
      NT = (XMAX-XMIN)/DX+1.2
      NO = N1-1
    2 IF(NO.GT.0) GO TO 3
      NO = N1
      N1 = N2
      N2 = N1+1
    3 IF(N2.LE.NT) GO TO 4
      N2 = N1
      N1 = NO
      NO = N1-1
    4 XXX = FLOAT(NO)*DX+XMIN
      DX2 = DX**2
      A = (TABLE(N2)-2.0*TABLE(N1)+TABLE(NO))/(2.0*DX2)
      B = (TABLE(N1)-TABLE(NO))/DX-A*(2.0*XXX-DX)
      C = TABLE(N1)-(A*XXX**2+B*XXX)
      Y = (A*XLK+B)*XLK+C
      SLOPE = 2.0 * A * XLK + B
      RETURN
      END
```

```
      SUBROUTINE INTRP5(INDX)                                           INT50010
C             HVOSM-RD2 VERSION                                         INT50020
C             REVISED OCTOBER 1975   CALSPAN CORPORATION                INT50030
      COMMON/INPT/PHIO,THETAO,PSIO,PO,QO,RO,XCOP,YCOP,ZCOP,UO,VO,WO,    INT50040
     1         A,B,DEL10,DEL20,DEL30,PHIRO,DEL10D,DEL20D,DEL30D,        INT50050
     2         PHIROD,TF,TR,ZF,ZR,RHO,AKRS,XMUR,                        INT50060
     3         XMS,XMUF,XIX,XIY,XIZ,XIXZ,CF,AKF,XLAMF,OMEGF,CFP,EPSF,INT50070
     4         RF,CR,AKR,XLAMR,OMEGR,CRP,EPSR,RR,TS,THMAX,DTCOMP,TO,   INT50080
     5         T1,DTCMP1,DTPRNT,MODE,EBAR,EM,AAA,HMAX,HMIN,BET,G,       INT50090
     6         HED(36),DADE(3),XIR,X1,Y1,Z1,X2,Y2,Z2,PHIC(50),DELB,     INT50100
     7         DELE,DDEL,NDEL,PSIF(50),TQF(50),TQR(50),TB,TE,TINCR,     INT50110
     8         NZTAB,NZ5,XBDRY(4,5),PSBDRY(4,5),YBDRY(2,5),NBX(5),      INT50120
     9         NBY(5),NTBL1,NTBL2,NTBL3,ZGP(21,21,5)                    INT50130
      COMMON/INPT/XB(5),XE(5),XINCR(5),NX(5),YB(5),YE(5),YINCR(5),NY(5),INT50140
     1        XXZGP5(21),YYZGP5(21),AMUG(5),PSBDRO(4,5),UVWMIN,PQRMIN  INT50150
      COMMON /DIMV/X1P,X2P,X3P,X4P,Y1P,Y2P,Y3P,Y4P,Z1P,Z2P,Z3P,Z4P,PHI1,INT50160
     1          PHI2,PHI3,PHI4,PSI1,PSI2,PSI3,PSI4,CAYW(4),CBYW(4),     INT50170
     2          CGYW(4),ZPGI(4),THGI(4),PHGI(4),CPG(4),SPG(4),CTG(4),INT50180
     3          STG(4),CAGZ(4),CBGZ(4),CGGZ(4),D1(4),D2(4),D3(4),       INT50190
     4          XLM1(4),XLM2(4),XLM3(4),AMTX(3,3),CMTX(3,4),XGPP(4),    INT50200
     5          YGPP(4),ZGPP(4),DMATX(10,11),DELTA(4),CAR(4),CBR(4),    INT50210
     6          CGR(4),FR(4),HI(4),FC(4),TI(4),AX(4),BX(4),CX(4),       INT50220
     7          CTXG(4),UG(4),STXG(4),AY(4),BY(4),CY(4),CPYG(4),        INT50230
     8          SPYG(4),VG(4),PSIIP(4),PHICI(4),CAC(4),CBC(4),CGC(4),INT50240
     9          FCXU(4),FCYU(4),FCZU(4),FS(4),CAXW(4),CBXW(4),CGXW(4)INT50250
      COMMON /DIMV/AS(4),BS(4),CS(4),CAS(4),CBS(4),CGS(4),BETP(4),      INT50260
     1          BETBR(4),FSXU(4),FSYU(4),FSZU(4),FRXU(4),FRYU(4),       INT50270
     2          FRZU(4),FXU(4),FYU(4),FZU(4),SI(4),F1FI(2),F1RI(2),     INT50280
     3          F2FI(2),F2RI(2),CAH(4),CBH(4),CGH(4)                    INT50290
      DIMENSION XP(4),YP(4),ZP(4),PHII(4),PSII(4)                       INT50300
      EQUIVALENCE (XP(1),X1P),(YP(1),Y1P),(ZP(1),Z1P),(PHII(1),PHI1),   INT50310
     1          (PSII(1),PSI1)                                          INT50320
      COMMON /COMP/SUMM,THETN,PHIN,PSIN,PI,RAD,GAM1,GAM2,GAM3,GAM4,GAM5,INT50330
     1         GAM6,GAM7,GAM8,GAM9,THETT,PHIT,PSIT,ZRO,TRO2,            INT50340
     2          TFO2,TIZ,RHO2,RHOMUR,AMUF,BMUR,ZPR,TM4,RHMR2,AO2APB,    INT50350
     3          BO2APB,RFTF,TSO2,RRTS,BROMUR,XMUFO2,AXMFO2,XMTFO4,      INT50360
     4          XIZR,RTR,RHMR2I,XIXP,XIZP,XIXZP,XIYZP,D1PD2,D1MD2,      INT50370
     5          ZRD3,ZRD3R,ZFD3R,ZFD12,TIZ2,TG61,DD1P2,DD1M2,RPR,PHRPINT50380
     6         ,TANTP,SPHTP,CPHTP,SECTP,SFXS,SFYS,SFZS,SNPS,SNTS,       INT50390
     7          SNPSS,TPR,CAY,CBY,CGY,CAX,CBX,CGX,SFYU,SFXU,SFYUF,      INT50400
     8          SFYUR,SFZU,COSTH,SINTH,COSPS,SINPS,COSPH,SINPH,ANG1,    INT50410
     9          ANG2,CPHI,SPHI,CPSI,SPSI,P1,P7,P3,P4,P5,P6,TX,TY,TZ     INT50420
      COMMON /COMP/TRH,DISTX,DISTY,DISTD,DISTS,D21,ZETA4,ZETA4D,ZETA3,  INT50430
     1          ZETA3D,SFZ1,SNPU,SNTU,HCGH1,HCGH2,HCGH3,HCGH4,TERM1,    INT50440
     2          TERM2,SNPSU,SNPR,HCBH1,HCBH2,HCBH3,HCBH4,HCAH1,HCAH2,INT50450
     3          HCAH3,HCAH4,UQ,WP,UR,QR,VP,PR,P2,Q2,R2,VR,WQ,PQ,PHIR2INT50460
     4         ,PHIRD2,RPHRD,GCTH,GSTH,GCTSP,GCTCP,XXX,YYY,IX,IY,XX1,INT50470
     5          XX2,YY1,YY2,THG1,THG2,PHG1,PHG2,ZZ1,ZZ2,LLL             INT50480
      DIMENSION HCAH(4),HCBH(4),HCGH(4)                                 INT50490
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      EQUIVALENCE (HCAH(1),HCAH1),(HCBH(1),HCBH1),(HCGH(1),HCGH1)
      COMMON /COMPN/ FRSP(4),FRCP(4),ICBHIT,JCBHIT,
     1               DPSINT,TANPC1,TANPC2,PHIC1R,PHIC2R,AMUCMP,PHI1D,
     2               PHI2D,LCB1(4),LCB2(4),IHIT,AJMTX(3,3),BMTX(3,3),
     3               SFRX(4),SFRY(4),SFRZ(4),T1PSI,T2PSI,XMUGI(4)
      LOGICAL LCB1,LCB2
      COMMON /TIRIN/ AKT(4),SIGT(4),XLAMT(4),A0(4),A1(4),A2(4),A3(4),
     1               A4(4),OMEGT(4),AMU(4),RW(4),FJP(35,4),A234(4),
     2               A12(4),OMT2A2(4),OMT2M1(4),A23(4),ITIR(4)
C
C     NWHEEL = INDX
C     IXBDRY = 0
C     IYBDRY = 0
C     XLCEPT=0.0
C     XRCEPT=0.0
C     I5 = 0
C
      ERR = 0.0
   10 XXX = XP(INDX)
      YYY = YP(INDX)
      IT = 0
      DO 11 I=1,NZTAB
      IF( XB(I).EQ.XE(I) .OR. YB(I).EQ.YE(I)) GO TO 11
      IF(XXX.GE.XB(I).AND.XXX.LE.XE(I).AND.YYY.GE.YB(I).AND.YYY.LE.YE(I)
     X ) IT =I
   11 CONTINUE
      IF(IT.NE.0) GO TO 15
   13 ZPGI(INDX)= 0.0
      THGI(INDX)= 0.0
      PHGI(INDX)= 0.0
      XMUGI(INDX) = AMU(INDX)
      RETURN
C               ITV = 1 IDENTIFIES THE VARIABLE INCREMENT TABLE HERE.
   15 ITV = 0
      IF( IT.EQ. NZTAB .AND. NZ5.NE.0) ITV = 1
      XMUGI(INDX) = AMU(INDX)*AMUG(IT)
      XBT = XB(IT)
      XET = XE(IT)
      YBT = YB(IT)
      NXT = NX(IT)
      NYT = NY(IT)
      NBXT= NBX(IT)
      NBYT= NBY(IT)
      IF(ITV.GE.1) GO TO 20
C       TABLES WITH CONSTANT INCREMENT
      XINCRT  =  XINCR(IT)
      YINCRT  =  YINCR(IT)
      IX =(XXX-XBT)/XINCRT + 1.0
      IY =(YYY-YBT)/YINCRT + 1.0
      XX1 = XBT + FLOAT(IX-1)*XINCRT
      XX2 = XX1 + XINCRT
```

```
      YY1 = YBT + FLOAT(IY-1)*YINCRT                                    INT51010
      YY3 = YY1 + YINCRT                                                INT51020
      GO TO 40                                                          INT51030
C       IX IS LOW INDEX FOR X , IY IS LOW INDEX FOR Y                   INT51040
C       FLOAT(IX-1) IS   COUNT   OF INCREMENTS                          INT51050
C      VARIABLE INCREMENT TABLE (ARGUMENTS GIVEN, XXZPG5(21),YYZPG5(21))INT51060
   20 DO 22 I=2,NXT                                                     INT51070
      IF (XXZGP5(I) - XXX) 22,21,21                                     INT51080
   21 IXX = I                                                           INT51090
      GO TO 25                                                          INT51100
   22 CONTINUE                                                          INT51110
      IXX = NXT                                                         INT51120
   25 IX = IXX-1                                                        INT51130
      IF (XXZGP5(IX) -XXZGP5(IXX)) 27,26,27                             INT51140
   26 ERR = 1.0                                                         INT51150
      GO TO 13                                                          INT51160
   27 DO 29 I=2,NYT                                                     INT51170
      IF (YYZGP5(I) - YYY) 29,28,28                                     INT51180
   28 IYY= I                                                            INT51190
      GO TO 30                                                          INT51200
   29 CONTINUE                                                          INT51210
      IYY= NYT                                                          INT51220
   30 IY = IYY - 1                                                      INT51230
      IF(YYZGP5(IY)    - YYZGP5(IYY))35,26,35                           INT51240
   35 XX1 = XXZGP5(IX)                                                  INT51250
      XX2 = XXZGP5(IXX)                                                 INT51260
      YY1 = YYZGP5(IY)                                                  INT51270
      YY3 = YYZGP5(IYY)                                                 INT51280
      XINCRT = XX2 - XX1                                                INT51290
      YINCRT = YY3 - YY1                                                INT51300
   40 XX3 = XX1                                                         INT51310
      XX4 = XX2                                                         INT51320
C     SEARCH FOR Y BOUNDARIES IN THIS MESH.Y BOUNDARIES HAVE CONSTANT Y.INT51330
      IF (NBYT .EQ. 0) GO TO 54                                         INT51340
      JJ = 0                                                            INT51350
      DO 41 I= 1,NBYT                                                   INT51360
      IF(YY1.GE.YBDRY(I,IT).OR. YBDRY(I,IT).GT.YY3) GO TO 41            INT51370
      JJ = I                                                            INT51380
C                                                                       INT51390
C     IYBDRY = I                                                        INT51400
C                                                                       INT51410
      GO TO 42                                                          INT51420
   41 CONTINUE                                                          INT51430
   42 IF(JJ.EQ.0) GO TO 54                                              INT51440
      IF(YYY.GE.YBDRY(JJ,IT))GO TO 50                                   INT51450
      YY3 = YY1                                                         INT51460
      IF(ITV.GE.1) GO TO 44                                             INT51470
   43 YY1 = YY3 - YINCRT                                                INT51480
      IY = IY -1                                                        INT51490
      GO TO 54                                                          INT51500
   44 YY1 = YYZGP5(IY-1)                                                INT51510
```

```
      IY = IY-1
      YINCRT = YY3 - YY1
      GO TO 54
   50 YY1 = YY3
      IF(ITV.GE.1) GO TO 52
   51 YY3 = YY1 + YINCRT
      IY = IY + 1
      GO TO 54
   52 YY3 = YYZGP5(IY +2)
      IY = IY + 1
      YINCRT =  YY3 - YY1
   54 YY2 = YY1
      YY4 = YY3
C       SEARCH FOR SLANTED BOUNDARIES
      IF (NBXT .EQ. 0) GO TO 61
      II = 0
      DO 60 I=1,NBXT
      XBDRT = XBDRY(I,IT)
C             PI AND 2.*PI ARE SINGULARITIES FOR COTAN
      IF( AMOD(PSBDRY(I,IT) , PI)  .EQ. 0.0) GO TO 60
      CTNPSB = COTAN(PSBDRY(I,IT))
      XLCEPT =  XBDRT + (YY1-YBT)*CTNPSB
      XRCEPT =  XBDRT + (YY3-YBT)*CTNPSB
      II= I
      IF( XX1.LE.XLCEPT .AND. XLCEPT.LE.XX2) GO TO 80
      IF(XLCEPT.LE.XX1 .AND. XRCEPT.GT.XX3) GO TO 80
      IF(XLCEPT.GE.XX2 .AND. XRCEPT.LT.XX4) GO TO 80
   60 CONTINUE
C       NO SLANT BOUNDARY IN THIS MESH
   61 XXMXX1 = XXX-XX1
      YYMYY1 = YYY-YY1
      ZPG1 = ZGP(IX ,IY ,IT)
      ZPG2 = ZGP(IX+1 ,IY ,IT)
      ZPG3 = ZGP(IX ,IY+1 ,IT)
      ZPG4 = ZGP(IX +1,IY+1 ,IT)
      ZZ1 =  ZPG1 + XXMXX1* (ZPG2-ZPG1)/XINCRT
      ZZ2 =  ZPG3 + XXMXX1* (ZPG4-ZPG3)/XINCRT
      ZPGI(INDX) = ZZ1 + YYMYY1*(ZZ2-ZZ1)/YINCRT
      THG1 = ATAN2 ((ZPG1-ZPG2),XINCRT)
      THG3 = ATAN2 ((ZPG3-ZPG4),XINCRT)
      THGI(INDX) =  THG1 + YYMYY1 *(THG3- THG1)/YINCRT
      IF(YYMYY1) 62,65,63
   62 ZPH1 = ZZ1
      ZYINCR =    -YYMYY1
      GO TO 67
   63 IF( YY3- YYY) 65,64,65
   64 PHGI(INDX) = ATAN2( (ZZ2 - ZZ1)/YINCRT, COS(THG1))
C     NOTE THG1, AS ROLL REFERENCE IS TO POINT 1 HERE
      GO TO 68
   65 ZPH1 = ZZ2
      ZYINCR =      YY3 - YYY
```

```
   67 PHGI(INDX) = ATAN2( (ZPH1-ZPGI(INDX))/ZYINCR, COS(THGI(INDX)))     INT52030
   68 RETURN                                                             INT52040
C  68 ZPGI10 = ZPGI(INDX)                                                INT52050
C     THGI10 = THGI(INDX)/RAD                                            INT52060
C     PHGI10 = PHGI(INDX)/RAD                                            INT52070
C3000 RETURN                                                             INT52080
C        SLANT BOUNDARY IN THIS MESH                                     INT52090
   80 ZXINCR = XINCRT                                                    INT52100
C                                                                        INT52110
C     IXBDRY = II                                                        INT52120
C                                                                        INT52130
      IF( XXX .GT.(XBDRT + (YYY - YBT)* CTNPSB) ) GO TO 140              INT52140
C                                                                        INT52150
C     WHEEL HAS NOT CROSSED THE SLANT BOUNDARY, STEP BACK ON X ,PERHAPS.INT52160
C     INDEX FOR HIGH GRID X IS IX+1, (XX2 AT IX+1,IY),(XX4 AT IX+1,IY+1)INT52170
C        COUNT OF CONSTANT INCREMENTS FOR XX2 IS IX                      INT52180
      NXW = IX                                                           INT52190
      IF(ITV.GE.1) GO TO 93                                              INT52200
   83 XX2W = XX2 + XINCRT                                                INT52210
      DO 85 I=1,NXW                                                      INT52220
      XX2W = XX2W - XINCRT                                               INT52230
      IF( XX2W .GE. XLCEPT) GO TO 85                                     INT52240
      IX2W= IX +2 - I                                                    INT52250
      GO TO 90                                                           INT52260
   85 CONTINUE                                                           INT52270
      IX2W = 2                                                           INT52280
      XX2W = XBT+ XINCRT                                                 INT52290
   90 XX1 = XX2W - XINCRT                                                INT52300
      XX4W = XX4 + XINCRT                                                INT52310
      DO 92  I=1,NXW                                                     INT52320
      XX4W = XX4W- XINCRT                                                INT52330
      IF(XX4W .GE. XRCEPT) GO TO 92                                      INT52340
      IX4W = IX  +2 - I                                                  INT52350
      GO TO  100                                                         INT52360
   92 CONTINUE                                                           INT52370
      IX4W = 2                                                           INT52380
      XX4W = XBT+ XINCRT                                                 INT52390
      GO TO 100                                                          INT52400
   93 NXW5 = IX                                                          INT52410
      NXWW = IX +2                                                       INT52420
      DO 95  I= 1,NXW5                                                   INT52430
      IX2W = NXWW - I                                                    INT52440
      IF( XXZGP5(IX2W) .LT. XLCEPT) GO TO 96                             INT52450
   95 CONTINUE                                                           INT52460
      IX2W = 2                                                           INT52470
   96 XX2W = XXZGP5(IX2W)                                                INT52480
      XX1    = XXZGP5(IX2W-1)                                            INT52490
      XINCRT =  XX2W - XX1                                               INT52500
      DO 97  I= 1,NXW5                                                   INT52510
      IX4W = NXWW - I                                                    INT52520
      IF(XXZGP5(IX4W) .LT. XRCEPT) GO TO 98                              INT52530
```

```
   97 CONTINUE
      IX4W =2
   98 XX4W = XXZGP5(IX4W)
  100 IX1W = IX2W -1
      IX3W = IX4W -1
      IF(IX1W  -   IX3W) 104,103,104
  103 IX = IX1W
      GO TO 61
  104 ZPG1 = ZGP(IX1W, IY, IT)
      ZPG2 = ZGP(IX2W, IY, IT)
      ZPG3 = ZGP(IX3W, IY+1, IT)
      ZPG4 = ZGP(IX4W, IY+1, IT)
      IF(IX2W - IX3W) 106,107,110
  106 ZPH1  =  ZGP(IX3W-1 ,IY+1, IT)
C          ZPH1 IS POINT FIVE HERE
      GO TO 108
  107 ZPH1   = ZPG3
  108 ZPH2   = ZPG2
      ZTH1   = ZPG3
      ZTH2   = ZPG4
      IF(ITV.GE.1)ZXINCR = XXZGP5(IX4W) - XXZGP5(IX3W)
      GO TO 115
  110 IF(IX1W - IX4W) 115,112,111
  111 I5 =MAXO(IX1W-1 ,1)
C         ZPH2  IS POINT FIVE HERE
      ZPH2    = ZGP(I5, IY,IT)
      GO TO 113
  112 ZPH2    = ZPG1
  113 ZPH1    = ZPG4
      ZTH1    = ZPG1
      ZTH2    = ZPG2
      IF(ITV.GE.1)ZXINCR = XXZGP5(IX2W) - XXZGP5(IX1W)
  115 ZZZ1  =  ZPG2
      XXMXX1 = XXX - XX2W
      YYMYY1 = YYY - YY2
      GO TO 180
C          WHEEL HAS CROSSED SLANT BOUNDARY. STEP AHEAD ON X, PERHAPS.
  140 NXW = NXT -1
      KXW = IX
      IF(ITV.GE.1) GO TO 153
  143 XX1W = XX1- XINCRT
      DO 145 I = KXW,NXW
      XX1W = XX1W + XINCRT
      IF(XX1W .LT. XLCEPT) GO TO 145
      IX1W = I
      GO TO 150
  145 CONTINUE
      XX1W = XET- XINCRT
      IX1W = NXW
  150 XX1 = XX1W
      XX3W = XX3 - XINCRT
```

```
      DO 152 I= KXW ,NXW                                               INT53050
      XX3W = XX3W + XINCRT                                             INT53060
      IF(XX3W .LT. XRCEPT) GO TO 152                                   INT53070
      IX3W = I                                                         INT53080
      GO TO 160                                                        INT53090
  152 CONTINUE                                                         INT53100
      IX3W = NXW                                                       INT53110
      XX3W = XET- XINCRT                                               INT53120
      GO TO 160                                                        INT53130
  153 DO 155  I = KXW, NXW                                             INT53140
      IF(XXZGP5(I) .LT. XLCEPT) GO TO 155                              INT53150
      IX1W = I                                                         INT53160
      GO TO 156                                                        INT53170
  155 CONTINUE                                                         INT53180
      IX1W = NXW                                                       INT53190
  156 XX1W = XXZGP5(IX1W)                                              INT53200
      XX1  = XX1W                                                      INT53210
      XINCRT =  XXZGP5(IX1W + 1) - XX1                                 INT53220
      DO 157 I= KXW ,NXW                                               INT53230
      IF(XXZGP5(I) .LT. XRCEPT) GO TO 157                              INT53240
      IX3W = I                                                         INT53250
      GO TO 158                                                        INT53260
  157 CONTINUE                                                         INT53270
      IX3W = NXW                                                       INT53280
  158 XX3W = XXZGP5(IX3W)                                              INT53290
  160 IX2W = IX1W + 1                                                  INT53300
      IX4W = IX3W + 1                                                  INT53310
      IF(IX1W - IX3W) 164,163,164                                      INT53320
  163 IX = IX1W                                                        INT53330
      GO TO 61                                                         INT53340
  164 ZPG1 = ZGP(IX1W,IY,IT)                                           INT53350
      ZPG2 = ZGP(IX2W,IY,IT)                                           INT53360
      ZPG3 = ZGP(IX3W,IY+1,IT)                                         INT53370
      ZPG4 = ZGP(IX4W,IY+1,IT)                                         INT53380
      IF(IX2W - IX3W) 166,167,170                                      INT53390
  166 ZPH2 = ZGP( IX2W+1,IY,IT)                                        INT53400
C         ZPH2 IS POINT FIVE HERE                                      INT53410
      GO TO 168                                                        INT53420
  167 ZPH2 = ZPG2                                                      INT53430
  168 ZPH1 = ZPG3                                                      INT53440
      ZTH1 = ZPG1                                                      INT53450
      ZTH2 = ZPG2                                                      INT53460
      IF(ITV.GE.1)ZXINCR = XXZGP5(IX2W) -XXZGP5(IX1W)                  INT53470
      GO TO 175                                                        INT53480
  170 IF(IX1W - IX4W) 175,172,171                                      INT53490
  171 I5 = MINO(IX4W+1,NXT)                                            INT53500
C       ZPH1 IS POINT FIVE HERE                                        INT53510
      ZPH1 = ZGP(I5,IY+1,IT)                                           INT53520
      GO TO 173                                                        INT53530
  172 ZPH1 = ZPG4                                                      INT53540
  173 ZPH2 = ZPG1                                                      INT53550
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    ZTH1 = ZPG3
    ZTH2 = ZPG4
    IF(ITV.GE.1)ZXINCR= XXZGP5(IX4W) - XXZGP5(IX3W)
175 ZZZ1 = ZPG1
    XXMXX1 = XXX - XX1
    YYMYY1 = YYY - YY1
180 ZTH12 =  ZTH1-ZTH2
    TTANTH =  ZTH12/ZXINCR
    THGI(INDX) = ATAN2( ZTH12   , ZXINCR)
    TCOSTH = COS(THGI(INDX))
    PFAC = (ZPH1 - ZPH2)/YINCRT
    PHGI(INDX) = ATAN2( PFAC, TCOSTH)
    IF(TCOSTH) 186,185,186
185 TTANPH = 0.0
    GO TO 187
186 TTANPH =  PFAC/TCOSTH
187 ZPGI(INDX) = ZZZ1 + YYMYY1*TCOSTH*TTANPH - XXMXX1* TTANTH
    RETURN
    END
```

```
      SUBROUTINE MATRIX
C               HVOSM-RD2 VERSION
C               REVISED OCTOBER 1975   CALSPAN CORPORATION
      COMMON/INPT/PHIO,THETAO,PSIO,PO,QO,RO,XCOP,YCOP,ZCOP,UO,VO,WO,
     1            A,B,DEL10,DEL20,DEL30,PHIRO,DEL10D,DEL20D,DEL30D,
     2            PHIROD,TF,TR,ZF,ZR,RHO,AKRS,XMUR,
     3            XMS,XMUF,XIX,XIY,XIZ,XIXZ,CF,AKF,XLAMF,OMEGF,CFP,EPSF,
     4            RF,CR,AKR,XLAMR,OMEGR,CRP,EPSR,RR,TS,THMAX,DTCOMP,TO,
     5            T1,DTCMP1,DTPRNT,MODE,EBAR,EM,AAA,HMAX,HMIN,BET,G,
     6            HED(36),DADE(3),XIR,X1,Y1,Z1,X2,Y2,Z2,PHIC(50),DELB,
     7            DELE,DDEL,NDEL,PSIF(50),TQF(50),TQR(50),TB,TE,TINCR,
     8            NZTAB,NZ5,XBDRY(4,5),PSBDRY(4,5),YBDRY(2,5),NBX(5),
     9            NBY(5),NTBL1,NTBL2,NTBL3,ZGP(21,21,5)
      COMMON/INPT/XB(5),XE(5),XINCR(5),NX(5),YB(5),YE(5),YINCR(5),NY(5),
     1          XXZGP5(21),YYZGP5(21),AMUG(5),PSBDRO(4,5),UVWMIN,PQRMIN
      COMMON /INTG/NEQ,T,DT,VAR(50),DER(50)
      EQUIVALENCE (U,VAR(1)),(V,VAR(2)),(W,VAR(3)),(P,VAR(4)),(Q,VAR(5))
     1           ,(R,VAR(6)),(DEL1,VAR(7)),(DEL1D,VAR(8)),(DEL2,VAR(9)),
     2            (DEL2D,VAR(10)),(DEL3,VAR(11)),(DEL3D,VAR(12)),
     3            (PHIR,VAR(13)),(PHIRD,VAR(14)),(THETTP,VAR(15)),
     4            (PHITP,VAR(16)),(PSITP,VAR(17)),(XCP,VAR(18)),
     5            (YCP,VAR(19)),(ZCP,VAR(20)),(PSIFI,VAR(21)),
     6            (PSIFID,VAR(22))
      EQUIVALENCE (DU,DER(1)),(DV,DER(2)),(DW,DER(3)),(DP,DER(4)),
     1            (DQ,DER(5)),(DR,DER(6)),(DDEL1,DER(7)),(DDEL1D,DER(8))
     2           ,(DDEL2,DER(9)),(DDEL2D,DER(10)),(DDEL3,DER(11)),
     3            (DDEL3D,DER(12)),(DPHIR,DER(13)),(DPHIRD,DER(14)),
     4            (DTHTTP,DER(15)),(DPHITP,DER(16)),(DPSITP,DER(17)),
     5            (DXCP,DER(18)),(DYCP,DER(19)),(DZCP,DER(20)),
     6            (DPSIFI,DER(21)),(DDPSFI,DER(22))
      EQUIVALENCE (VAR(9),PHIF),(VAR(10),PHIFD),(DER(9),DPHIF),
     1            (DER(10),DPHIFD)
      EQUIVALENCE (VAR(13),DEL4),(VAR(14),DEL4D),(DER(13),DDEL4),
     1            (DER(14),DDEL4D)
      COMMON /DIMV/X1P,X2P,X3P,X4P,Y1P,Y2P,Y3P,Y4P,Z1P,Z2P,Z3P,Z4P,PHI1,
     1             PHI2,PHI3,PHI4,PSI1,PSI2,PSI3,PSI4,CAYW(4),CBYW(4),
     2             CGYW(4),ZPGI(4),THGI(4),PHGI(4),CPG(4),SPG(4),CTG(4),
     3             STG(4),CAGZ(4),CBGZ(4),CGGZ(4),D1(4),D2(4),D3(4),
     4             XLM1(4),XLM2(4),XLM3(4),AMTX(3,3),CMTX(3,4),XGPP(4),
     5             YGPP(4),ZGPP(4),DMATX(10,11),DELTA(4),CAR(4),CBR(4),
     6             CGR(4),FR(4),HI(4),FC(4),TI(4),AX(4),BX(4),CX(4),
     7             CTXG(4),UG(4),STXG(4),AY(4),BY(4),CY(4),CPYG(4),
     8             SPYG(4),VG(4),PSIIP(4),PHICI(4),CAC(4),CBC(4),CGC(4),
     9             FCXU(4),FCYU(4),FCZU(4),FS(4),CAXW(4),CBXW(4),CGXW(4)
      COMMON /DIMV/AS(4),BS(4),CS(4),CAS(4),CBS(4),CGS(4),BETP(4),
     1             BETBR(4),FSXU(4),FSYU(4),FSZU(4),FRXU(4),FRYU(4),
     2             FRZU(4),FXU(4),FYU(4),FZU(4),SI(4),F1FI(2),F1RI(2),
     3             F2FI(2),F2RI(2),CAH(4),CBH(4),CGH(4)
      DIMENSION XP(4),YP(4),ZP(4),PHII(4),PSII(4)
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      EQUIVALENCE (XP(1),X1P),(YP(1),Y1P),(ZP(1),Z1P),(PHII(1),PHI1),    MTRX0500
     1            (PSII(1),PSI1)                                         MTRX0510
      COMMON /COMP/SUMM,THETN,PHIN,PSIN,PI,RAD,GAM1,GAM2,GAM3,GAM4,GAM5,MTRX0520
     1            GAM6,GAM7,GAM8,GAM9,THETT,PHIT,PSIT,ZRO,TRO2,          MTRX0530
     2             TFO2,TIZ,RHO2,RHOMUR,AMUF,BMUR,ZPR,TM4,RHMR2,AO2APB,  MTRX0540
     3             BO2APB,RFTF,TSO2,RRTS,BROMUR,XMUFO2,AXMFO2,XMTFO4,    MTRX0550
     4             XIZR,RTR,RHMR2I,XIXP,XIZP,XIXZP,XIYZP,D1PD2,D1MD2,    MTRX0560
     5             ZRD3,ZRD3R,ZFD3R,ZFD12,TIZ2,TG61,DD1P2,DD1M2,RPR,PHRPMTRX0570
     6            ,TANTP,SPHTP,CPHTP,SECTP,SFXS,SFYS,SFZS,SNPS,SNTS,     MTRX0580
     7             SNPSS,TPR,CAY,CBY,CGY,CAX,CBX,CGX,SFYU,SFXU,SFYUF,    MTRX0590
     8             SFYUR,SFZU,COSTH,SINTH,COSPS,SINPS,COSPH,SINPH,ANG1,  MTRX0600
     9             ANG2,CPHI,SPHI,CPSI,SPSI,P1,P7,P3,P4,P5,P6,TX,TY,TZ   MTRX0610
      COMMON /COMP/TRH,DISTX,DISTY,DISTD,DISTS,D21,ZETA4,ZETA4D,ZETA3,   MTRX0620
     1             ZETA3D,SFZ1,SNPU,SNTU,HCGH1,HCGH2,HCGH3,HCGH4,TERM1,  MTRX0630
     2             TERM2,SNPSU,SNPR,HCBH1,HCBH2,HCBH3,HCBH4,HCAH1,HCAH2,MTRX0640
     3             HCAH3,HCAH4,UQ,WP,UR,QR,VP,PR,P2,Q2,R2,VR,WQ,PQ,PHIR2MTRX0650
     4            ,PHIRD2,RPHRD,GCTH,GSTH,GCTSP,GCTCP,XXX,YYY,IX,IY,XX1,MTRX0660
     5             XX2,YY1,YY2,THG1,THG2,PHG1,PHG2,ZZ1,ZZ2,LLL           MTRX0670
      DIMENSION HCAH(4),HCBH(4),HCGH(4)                                  MTRX0680
      EQUIVALENCE (HCAH(1),HCAH1),(HCBH(1),HCBH1),(HCGH(1),HCGH1)        MTRX0690
      COMMON/ADTNL/ U1,U2,U3,U4,V1,V2,V3,V4,W1,W2,W3,W4,                 MTRX0700
     1              XIYP,SPHIC,CPHIC,APTCH1,APTCH2,APTCH3,APTCH4,        MTRX0710
     2              SLOPE1,SLOPE2,XTRA(300)                              MTRX0720
      DIMENSION UI(4),VI(4),WI(4)                                        MTRX0730
      EQUIVALENCE (UI(1),U1),(VI(1),V1),(WI(1),W1)                       MTRX0740
      DIMENSION APITCH(4)                                                MTRX0750
      EQUIVALENCE (APITCH(1),APTCH1)                                     MTRX0760
    1 CALL CLEAR (DMATX,DMATX(10,11))                                    MTRX0770
      DMATX(1,1) = SUMM                                                  MTRX0780
      DMATX(1,5) = GAM2                                                  MTRX0790
      DMATX(1,6) = RHOMUR*PHIR                                           MTRX0800
    2 DMATX(2,2) = SUMM                                                  MTRX0810
       DMATX(2,4) = -GAM2                                                MTRX0820
      DMATX(2,6) = GAM1                                                  MTRX0830
      DMATX(2,10) = -RHOMUR                                              MTRX0840
    3 DMATX(3,3) = XMS                                                   MTRX0850
    4 DMATX(4,2) = -GAM3                                                 MTRX0860
      DMATX(4,4) = XIX+XIXP                                              MTRX0870
      DMATX(4,6) = -XIXZ-XIXZP                                           MTRX0880
      DMATX(4,10) = RHOMUR*ZRD3                                          MTRX0890
    5 DMATX(5,1) = GAM2                                                  MTRX0900
      DMATX(5,5) = XIY+XIYP                                              MTRX0910
      DMATX(5,6) = -XIYZP                                                MTRX0920
    6 DMATX(6,1) = DMATX(1,6)                                            MTRX0930
      DMATX(6,2) = GAM1                                                  MTRX0940
      DMATX(6,4) = DMATX(4,6)+BROMUR                                     MTRX0950
      DMATX(6,5) = -XIYZP                                                MTRX0960
      DMATX(6,6) = XIZR+XIZP                                             MTRX0970
      DMATX(6,10) = BROMUR                                               MTRX0980
    7 DMATX(7,3) = XMUFO2                                                MTRX0990
      DMATX(7,4) = XMTFO4                                                MTRX1000
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      DMATX(7,5) = -AXMFO2
      DMATX(7,7) = XMUFO2
    8 DMATX(8,3) = XMUFO2
      DMATX(8,4) = -XMTF04
      DMATX(8,5) = -AXMFO2
      DMATX(8,8) = XMUFO2
    9 DMATX(9,3) = XMUR
      DMATX(9,4) = -DMATX(1,6)
      DMATX(9,5) = BMUR
      DMATX(9,9) = XMUR
      DMATX(9,10) = DMATX(9,4)
   10 DMATX(10,2) = -RHOMUR
      DMATX(10,3) = DMATX(9,4)
      DMATX(10,4) = XIR+ZRD3R*RHOMUR
      DMATX(10,5) = -BROMUR*PHIR
      DMATX(10,6) = BROMUR
      DMATX(10,9) = DMATX(9,4)
      DMATX(10,10) = RHMR2I
   11 GCTSP = G*AMTX(3,2)
      GCTCP = G*AMTX(3,3)
   12 DMATX(1,11) = SUMM*(VR-WQ-GSTH)-GAM2*PR+RHOMUR*PHIR*PQ+GAM1*(Q2+
     1             R2)-GAM6*Q-2.0*RHOMUR*RPHRD+SFXS+SFXU
      DMATX(2,11) = SUMM*(WP-UR+GCTSP)+GAM6*P-GAM1*PQ-GAM2*QR-RHOMUR*
     1             PHIR*(P2+R2+PHIRD2)+SFYS+SFYU
      DMATX(3,11) = XMS*(UQ-VP+GCTCP)-SFZ1+SFZS
      DMATX(4,11) = GAM3*(UR-WP-GCTSP)+(XIXZ+XIXZP)*PQ-GAM7*P+(XIY-XIZ+
     1             XIXP)*QR-GAM4*(P2+R2)+RHOMUR*PHIR*ZRD3*PHIRD2+SNPS+
     2             SNPU
      DMATX(5,11) = XIXZ*(R2-P2)+(XIZ-XIX-XIYP)*PR+GAM2*(VR-WQ-GSTH)-
     1             (GAM7+2.*RHO*TG61)*Q+(XIXZP-BROMUR)*(Q2+R2)-
     2             XIYZP*PQ-2.0*XMUR*ZRD3R*RHO*RPHRD+SNTS+SNTU
   13 DMATX(6,11) = (XIX-XIY-GAM5)*PQ-(XIXZ+XIXZP-BROMUR)*QR+GAM8*Q+
     1             XIYZP*PR+GAM9*P+RHOMUR*PHIR*(VR-WQ-2.0*RHO*RPHRD-B*
     2             (Q2-P2-PHIRD2)-GSTH)+GAM1*(WP-UR+GCTSP)+SNPSS+SNPSU
      DMATX(7,11) = XMUFO2*(UQ-VP-A*PR-TFO2*QR+(ZF+DEL1)*(P2+Q2)+GCTCP)+
     1             FZU(1)+SI(1)
      DMATX(8,11) = XMUFO2*(UQ-VP-A*PR+TFO2*QR+(ZF+DEL2)*(P2+Q2)+GCTCP)+
     1             FZU(2)+SI(2)
      DMATX(9,11) = XMUR*(UQ-VP+RHO*PHIRD2+2.0*P*RHO*PHIRD+B*PR+RHO*PHIR
     1             *QR+ZRD3R*(P2+Q2)+GCTCP)+FZU(3)+FZU(4)+SI(3)+SI(4)
   14 DMATX(10,11) = RHOMUR*(UR-WP-2.0*P*(DEL3D-RHO*PHIR*PHIRD)-B*PQ+
     1               RHO*PHIR*(P2+R2)+ZRD3R*QR-GCTH*SIN(PHIT+PHIR))+
     2         PHIR*RHOMUR*(VP-UQ-2.0*P*RHO*PHIRD-B*PR-RHO*PHIR*QR-
     3               ZRD3R*(P2+Q2))-XIR*PHIR*(R2-Q2)-XIR*QR+
     4               SNPR
      RETURN
      END
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      SUBROUTINE MTRXIR                                                 MTXI0010
C              HVOSM-RD2 VERSION                                        MTXI0020
C              REVISED OCTOBER 1975   CALSPAN CORPORATION               MTXI0030
      COMMON/INPT/PHIO,THETAO,PSIO,PO,QO,RO,XCOP,YCOP,ZCOP,UO,VO,WO,    MTXI0040
     1            A,B,DEL10,DEL20,DEL30,PHIRO,DEL10D,DEL20D,DEL30D,     MTXI0050
     2            PHIROD,TF,TR,ZF,ZR,RHO,AKRS,XMUR,                     MTXI0060
     3            XMS,XMUF,XIX,XIY,XIZ,XIXZ,CF,AKF,XLAMF,OMEGF,CFP,EPSF,MTXI0070
     4            RF,CR,AKR,XLAMR,OMEGR,CRP,EPSR,RR,TS,THMAX,DTCOMP,TO, MTXI0080
     5            T1,DTCMP1,DTPRNT,MODE,EBAR,EM,AAA,HMAX,HMIN,BET,G,    MTXI0090
     6            HED(36),DADE(3),XIR,X1,Y1,Z1,X2,Y2,Z2,PHIC(50),DELB,  MTXI0100
     7            DELE,DDEL,NDEL,PSIF(50),TQF(50),TQR(50),TB,TE,TINCR,  MTXI0110
     8            NZTAB,NZ5,XBDRY(4,5),PSBDRY(4,5),YBDRY(2,5),NBX(5),   MTXI0120
     9            NBY(5),NTBL1,NTBL2,NTBL3,ZGP(21,21,5)                 MTXI0130
      COMMON/INPT/XB(5),XE(5),XINCR(5),NX(5),YB(5),YE(5),YINCR(5),NY(5),MTXI0140
     1          XXZGP5(21),YYZGP5(21),AMUG(5),PSBDRO(4,5),UVWMIN,PQRMIN MTXI0150
      COMMON /INTG/NEQ,T,DT,VAR(50),DER(50)                             MTXI0160
      EQUIVALENCE (U,VAR(1)),(V,VAR(2)),(W,VAR(3)),(P,VAR(4)),(Q,VAR(5))MTXI0170
     1           ,(R,VAR(6)),(DEL1,VAR(7)),(DEL1D,VAR(8)),(DEL2,VAR(9)),MTXI0180
     2            (DEL2D,VAR(10)),(DEL3,VAR(11)),(DEL3D,VAR(12)),       MTXI0190
     3            (PHIR,VAR(13)),(PHIRD,VAR(14)),(THETTP,VAR(15)),      MTXI0200
     4            (PHITP,VAR(16)),(PSITP,VAR(17)),(XCP,VAR(18)),        MTXI0210
     5            (YCP,VAR(19)),(ZCP,VAR(20)),(PSIFI,VAR(21)),          MTXI0220
     6            (PSIFID,VAR(22))                                      MTXI0230
      EQUIVALENCE (DU,DER(1)),(DV,DER(2)),(DW,DER(3)),(DP,DER(4)),      MTXI0240
     1            (DQ,DER(5)),(DR,DER(6)),(DDEL1,DER(7)),(DDEL1D,DER(8))MTXI0250
     2           ,(DDEL2,DER(9)),(DDEL2D,DER(10)),(DDEL3,DER(11)),      MTXI0260
     3            (DDEL3D,DER(12)),(DPHIR,DER(13)),(DPHIRD,DER(14)),    MTXI0270
     4            (DTHTTP,DER(15)),(DPHITP,DER(16)),(DPSITP,DER(17)),   MTXI0280
     5            (DXCP,DER(18)),(DYCP,DER(19)),(DZCP,DER(20)),         MTXI0290
     6            (DPSIFI,DER(21)),(DDPSFI,DER(22))                     MTXI0300
      EQUIVALENCE (VAR(9),PHIF),(VAR(10),PHIFD),(DER(9),DPHIF),         MTXI0310
     1            (DER(10),DPHIFD)                                      MTXI0320
      EQUIVALENCE (VAR(13),DEL4),(VAR(14),DEL4D),(DER(13),DDEL4),       MTXI0330
     1            (DER(14),DDEL4D)                                      MTXI0340
      COMMON /DIMV/X1P,X2P,X3P,X4P,Y1P,Y2P,Y3P,Y4P,Z1P,Z2P,Z3P,Z4P,PHI1,MTXI0350
     1             PHI2,PHI3,PHI4,PSI1,PSI2,PSI3,PSI4,CAYW(4),CBYW(4),  MTXI0360
     2             CGYW(4),ZPGI(4),THGI(4),PHGI(4),CPG(4),SPG(4),CTG(4),MTXI0370
     3             STG(4),CAGZ(4),CBGZ(4),CGGZ(4),D1(4),D2(4),D3(4),    MTXI0380
     4             XLM1(4),XLM2(4),XLM3(4),AMTX(3,3),CMTX(3,4),XGPP(4), MTXI0390
     5             YGPP(4),ZGPP(4),DMATX(10,11),DELTA(4),CAR(4),CBR(4), MTXI0400
     6             CGR(4),FR(4),HI(4),FC(4),TI(4),AX(4),BX(4),CX(4),    MTXI0410
     7             CTXG(4),UG(4),STXG(4),AY(4),BY(4),CY(4),CPYG(4),     MTXI0420
     8             SPYG(4),VG(4),PSIIP(4),PHICI(4),CAC(4),CBC(4),CGC(4),MTXI0430
     9             FCXU(4),FCYU(4),FCZU(4),FS(4),CAXW(4),CBXW(4),CGXW(4)MTXI0440
      COMMON /DIMV/AS(4),BS(4),CS(4),CAS(4),CBS(4),CGS(4),BETP(4),      MTXI0450
     1             BETBR(4),FSXU(4),FSYU(4),FSZU(4),FRXU(4),FRYU(4),    MTXI0460
     2             FRZU(4),FXU(4),FYU(4),FZU(4),SI(4),F1FI(2),F1RI(2),  MTXI0470
     3             F2FI(2),F2RI(2),CAH(4),CBH(4),CGH(4)                 MTXI0480
      DIMENSION XP(4),YP(4),ZP(4),PHII(4),PSII(4)                       MTXI0490
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      EQUIVALENCE (XP(1),X1P),(YP(1),Y1P),(ZP(1),Z1P),(PHII(1),PHI1),
     1            (PSII(1),PSI1)
      COMMON /COMP/SUMM,THETN,PHIN,PSIN,PI,RAD,GAM1,GAM2,GAM3,GAM4,GAM5,
     1            GAM6,GAM7,GAM8,GAM9,THETT,PHIT,PSIT,ZRO,TRO2,
     2             TFO2,TIZ,RHO2,RHOMUR,AMUF,BMUR,ZPR,TM4,RHMR2,AO2APB,
     3             BO2APB,RFTF,TSO2,RRTS,BROMUR,XMUFO2,AXMFO2,XMTFO4,
     4             XIZR,RTR,RHMR2I,XIXP,XIZP,XIXZP,XIYZP,D1PD2,D1MD2,
     5             ZRD3,ZRD3R,ZFD3R,ZFD12,TIZ2,TG61,DD1P2,DD1M2,RPR,PHRP
     6            ,TANTP,SPHTP,CPHTP,SECTP,SFXS,SFYS,SFZS,SNPS,SNTS,
     7             SNPSS,TPR,CAY,CBY,CGY,CAX,CBX,CGX,SFYU,SFXU,SFYUF,
     8             SFYUR,SFZU,COSTH,SINTH,COSPS,SINPS,COSPH,SINPH,ANG1,
     9             ANG2,CPHI,SPHI,CPSI,SPSI,P1,P7,P3,P4,P5,P6,TX,TY,TZ
      COMMON /COMP/TRH,DISTX,DISTY,DISTD,DISTS,D21,ZETA4,ZETA4D,ZETA3,
     1             ZETA3D,SFZ1,SNPU,SNTU,HCGH1,HCGH2,HCGH3,HCGH4,TERM1,
     2             TERM2,SNPSU,SNPR,HCBH1,HCBH2,HCBH3,HCBH4,HCAH1,HCAH2,
     3             HCAH3,HCAH4,UQ,WP,UR,QR,VP,PR,P2,Q2,R2,VR,WQ,PQ,PHIR2
     4            ,PHIRD2,RPHRD,GCTH,GSTH,GCTSP,GCTCP,XXX,YYY,IX,IY,XX1,
     5             XX2,YY1,YY2,THG1,THG2,PHG1,PHG2,ZZ1,ZZ2,LLL
      DIMENSION HCAH(4),HCBH(4),HCGH(4)
      EQUIVALENCE (HCAH(1),HCAH1),(HCBH(1),HCBH1),(HCGH(1),HCGH1)
      COMMON/ADTNL/ U1,U2,U3,U4,V1,V2,V3,V4,W1,W2,W3,W4,
     1              XIYP,SPHIC,CPHIC,APTCH1,APTCH2,APTCH3,APTCH4,
     2              SLOPE1,SLOPE2,XTRA(300)
      DIMENSION UI(4),VI(4),WI(4)
      EQUIVALENCE (UI(1),U1),(VI(1),V1),(WI(1),W1)
      DIMENSION APITCH(4)
      EQUIVALENCE (APITCH(1),APTCH1)
      COMMON /SUSCMP/ XMURO2,BXMRO2,XMTRO4,ZFO,TSFO2,RHOF2,RHFMUF,
     1                RHF2MF,RF2MFI,RTF,RRTR,D3PD4,D3MD4,D43,DD3P4,
     2                DD3M4,ZFD1RF,ZRD34,RFPF,RPF2M,WFMF,PHFP,PHIF2,
     3                PHIFD2,RPHFD,ZFD1,ZFD2,ZRD4,TPF,SLOPE3,SLOPE4,
     4                PHI3D,PHI4D,DTHF1,DTHF2,DTHR3,DTHR4,DTDD1,
     5                DTDD2,DTDD3,DTDD4,FJF(4),SNPF
C
      CALL CLEAR(DMATX(1,1),DMATX(10,11))
      DMATX(1,1) = SUMM
      DMATX(1,5) = GAM2
      DMATX(2,2) = SUMM
      DMATX(2,4) = -GAM2
      DMATX(2,6) = GAM1
      DMATX(3,3) = XMS
      DMATX(4,2) = -GAM2
      DMATX(4,4) = XIX+XIXP
      DMATX(4,6) = -XIXZ-XIXZP
      DMATX(5,1) = GAM2
      DMATX(5,5) = XIY+XIYP
      DMATX(5,6) = -XIYZP
      DMATX(6,2) = GAM1
      DMATX(6,4) = -XIXZ-XIXZP
      DMATX(6,5) = -XIYZP
      DMATX(6,6) = XIZ+XIZP
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 DMATX(7,3) = XMUFO2
 DMATX(7,4) = XMTFO4
 DMATX(7,5) = -AXMFO2
 DMATX(7,7) = XMUFO2
 DMATX(8,3) = XMUFO2
 DMATX(8,4) = -XMTFO4
 DMATX(8,5) = -AXMFO2
 DMATX(8,8) = XMUFO2
 DMATX(9,3) = XMURO2
 DMATX(9,4) = XMTRO4
 DMATX(9,5) = BXMRO2
 DMATX(9,9) = XMURO2
 DMATX(10,3) = XMURO2
 DMATX(10,4) = -XMTRO4
 DMATX(10,5) = BXMRO2
 DMATX(10,10) = XMURO2
 GCTSP = G*AMTX(3,2)
 GCTCP = G*AMTX(3,3)
 DMATX(1,11) = SUMM*(VR-WQ-GSTH)+GAM1*(Q2+R2)-GAM2*PR-GAM6*Q
1             +SFXU+SFXS
 DMATX(2,11) = SUMM*(WP-UR+GCTSP)-GAM1*PQ-GAM2*QR+GAM6*P
1             +SFYU+SFYS
 DMATX(3,11) = XMS*(UQ-VP+GCTCP)-SFZ1+SFZS
 DMATX(4,11) = -GAM2*(WP-UR+GCTSP)+(XIXZ+XIXZP)*PQ-XIYZP*(P2+R2)
1             +(XIY-XIZ+XIXP)*QR-GAM7*P+SNPU+SNPS
 DMATX(5,11) = GAM2*(VR-WQ-GSTH)-(XIX-XIZ+XIYP)*PR-GAM7*Q
1             +XIXZP*(Q2+R2)-XIYZP*PQ+XIXZ*(R2-P2)+SNTU+SNTS
 DMATX(6,11) = GAM1*(WP-UR+GCTSP)+(XIX-XIY-GAM5)*PQ-(XIXZ+XIXZP)
1             *QR+GAM8*Q+XIYZP*PR+GAM9*P+SNPSU+SNPSS
 DMATX(7,11) = XMUFO2*(UQ-VP+GCTCP-A*PR+ZFD1*(P2+R2)
1             -TFO2*QR)+FZU(1)+SI(1)
 DMATX(8,11) = XMUFO2*(UQ-VP+GCTCP-A*PR+ZFD2*(P2+R2)
1             +TFO2*QR)+FZU(2)+SI(2)
 DMATX(9,11) = XMURO2*(UQ-VP+GCTCP+B*PR+ZRD3*(P2+R2)
1             -TRO2*QR)+FZU(3)+SI(3)
 DMATX(10,11) = XMURO2*(UQ-VP+GCTCP+B*PR+ZRD4*(P2+R2)
1             +TRO2*QR)+FZU(4)+SI(4)
 RETURN
 END
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      SUBROUTINE MTRXSF
C               HVOSM-RD2 VERSION
C               REVISED OCTOBER 1975   CALSPAN CORPORATION
      COMMON/INPT/PHIO,THETAO,PSIO,PO,QO,RO,XCOP,YCOP,ZCOP,UO,VO,WO,
     1              A,B,DEL10,DEL20,DEL30,PHIRO,DEL10D,DEL20D,DEL30D,
     2              PHIROD,TF,TR,ZF,ZR,RHO,AKRS,XMUR,
     3              XMS,XMUF,XIX,XIY,XIZ,XIXZ,CF,AKF,XLAMF,OMEGF,CFP,EPSF,
     4              RF,CR,AKR,XLAMR,OMEGR,CRP,EPSR,RR,TS,THMAX,DTCOMP,TO,
     5              T1,DTCMP1,DTPRNT,MODE,EBAR,EM,AAA,HMAX,HMIN,BET,G,
     6              HED(36),DADE(3),XIR,X1,Y1,Z1,X2,Y2,Z2,PHIC(50),DELB,
     7              DELE,DDEL,NDEL,PSIF(50),TQF(50),TQR(50),TB,TE,TINCR,
     8              NZTAB,NZ5,XBDRY(4,5),PSBDRY(4,5),YBDRY(2,5),NBX(5),
     9              NBY(5),NTBL1,NTBL2,NTBL3,ZGP(21,21,5)
      COMMON/INPT/XB(5),XE(5),XINCR(5),NX(5),YB(5),YE(5),YINCR(5),NY(5),
     1            XXZGP5(21),YYZGP5(21),AMUG(5),PSBDRO(4,5),UVWMIN,PQRMIN
      COMMON /INTG/NEQ,T,DT,VAR(50),DER(50)
      EQUIVALENCE (U,VAR(1)),(V,VAR(2)),(W,VAR(3)),(P,VAR(4)),(Q,VAR(5))
     1            ,(R,VAR(6)),(DEL1,VAR(7)),(DEL1D,VAR(8)),(DEL2,VAR(9)),
     2             (DEL2D,VAR(10)),(DEL3,VAR(11)),(DEL3D,VAR(12)),
     3             (PHIR,VAR(13)),(PHIRD,VAR(14)),(THETTP,VAR(15)),
     4             (PHITP,VAR(16)),(PSITP,VAR(17)),(XCP,VAR(18)),
     5             (YCP,VAR(19)),(ZCP,VAR(20)),(PSIFI,VAR(21)),
     6             (PSIFID,VAR(22))
      EQUIVALENCE (DU,DER(1)),(DV,DER(2)),(DW,DER(3)),(DP,DER(4)),
     1             (DQ,DER(5)),(DR,DER(6)),(DDEL1,DER(7)),(DDEL1D,DER(8))
     2            ,(DDEL2,DER(9)),(DDEL2D,DER(10)),(DDEL3,DER(11)),
     3             (DDEL3D,DER(12)),(DPHIR,DER(13)),(DPHIRD,DER(14)),
     4             (DTHTTP,DER(15)),(DPHITP,DER(16)),(DPSITP,DER(17)),
     5             (DXCP,DER(18)),(DYCP,DER(19)),(DZCP,DER(20)),
     6             (DPSIFI,DER(21)),(DDPSFI,DER(22))
      EQUIVALENCE (VAR(9),PHIF),(VAR(10),PHIFD),(DER(9),DPHIF),
     1             (DER(10),DPHIFD)
      EQUIVALENCE (VAR(13),DEL4),(VAR(14),DEL4D),(DER(13),DDEL4),
     1             (DER(14),DDEL4D)
      COMMON /DIMV/X1P,X2P,X3P,X4P,Y1P,Y2P,Y3P,Y4P,Z1P,Z2P,Z3P,Z4P,PHI1,
     1               PHI2,PHI3,PHI4,PSI1,PSI2,PSI3,PSI4,CAYW(4),CBYW(4),
     2               CGYW(4),ZPGI(4),THGI(4),PHGI(4),CPG(4),SPG(4),CTG(4),
     3               STG(4),CAGZ(4),CBGZ(4),CGGZ(4),D1(4),D2(4),D3(4),
     4               XLM1(4),XLM2(4),XLM3(4),AMTX(3,3),CMTX(3,4),XGPP(4),
     5               YGPP(4),ZGPP(4),DMATX(10,11),DELTA(4),CAR(4),CBR(4),
     6               CGR(4),FR(4),HI(4),FC(4),TI(4),AX(4),BX(4),CX(4),
     7               CTXG(4),UG(4),STXG(4),AY(4),BY(4),CY(4),CPYG(4),
     8               SPYG(4),VG(4),PSIIP(4),PHICI(4),CAC(4),CBC(4),CGC(4),
     9               FCXU(4),FCYU(4),FCZU(4),FS(4),CAXW(4),CBXW(4),CGXW(4)
      COMMON /DIMV/AS(4),BS(4),CS(4),CAS(4),CBS(4),CGS(4),BETP(4),
     1               BETBR(4),FSXU(4),FSYU(4),FSZU(4),FRXU(4),FRYU(4),
     2               FRZU(4),FXU(4),FYU(4),FZU(4),SI(4),F1FI(2),F1RI(2),
     3               F2FI(2),F2RI(2),CAH(4),CBH(4),CGH(4)
      DIMENSION XP(4),YP(4),ZP(4),PHII(4),PSII(4)
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      EQUIVALENCE (XP(1),X1P),(YP(1),Y1P),(ZP(1),Z1P),(PHII(1),PHI1),   MTXS0500
     1            (PSII(1),PSI1)                                        MTXS0510
      COMMON /COMP/SUMM,THETN,PHIN,PSIN,PI,RAD,GAM1,GAM2,GAM3,GAM4,GAM5,MTXS0520
     1            GAM6,GAM7,GAM8,GAM9,THETT,PHIT,PSIT,ZRO,TRO2,         MTXS0530
     2             TFO2,TIZ,RHO2,RHOMUR,AMUF,BMUR,ZPR,TM4,RHMR2,AO2APB, MTXS0540
     3             BO2APB,RFTF,TSO2,RRTS,BROMUR,XMUFO2,AXMFO2,XMTFO4,   MTXS0550
     4             XIZR,RTR,RHMR2I,XIXP,XIZP,XIXZP,XIYZP,D1PD2,D1MD2,   MTXS0560
     5             ZRD3,ZRD3R,ZFD3R,ZFD12,TIZ2,TG61,DD1P2,DD1M2,RPR,PHRPMTXS0570
     6            ,TANTP,SPHTP,CPHTP,SECTP,SFXS,SFYS,SFZS,SNPS,SNTS,    MTXS0580
     7             SNPSS,TPR,CAY,CBY,CGY,CAX,CBX,CGX,SFYU,SFXU,SFYUF,   MTXS0590
     8             SFYUR,SFZU,COSTH,SINTH,COSPS,SINPS,COSPH,SINPH,ANG1, MTXS0600
     9             ANG2,CPHI,SPHI,CPSI,SPSI,P1,P7,P3,P4,P5,P6,TX,TY,TZ  MTXS0610
      COMMON /COMP/TRH,DISTX,DISTY,DISTD,DISTS,D21,ZETA4,ZETA4D,ZETA3,  MTXS0620
     1             ZETA3D,SFZ1,SNPU,SNTU,HCGH1,HCGH2,HCGH3,HCGH4,TERM1, MTXS0630
     2             TERM2,SNPSU,SNPR,HCBH1,HCBH2,HCBH3,HCBH4,HCAH1,HCAH2,MTXS0640
     3             HCAH3,HCAH4,UQ,WP,UR,QR,VP,PR,P2,Q2,R2,VR,WQ,PQ,PHIR2MTXS0650
     4            ,PHIRD2,RPHRD,GCTH,GSTH,GCTSP,GCTCP,XXX,YYY,IX,IY,XX1,MTXS0660
     5             XX2,YY1,YY2,THG1,THG2,PHG1,PHG2,ZZ1,ZZ2,LLL          MTXS0670
      DIMENSION HCAH(4),HCBH(4),HCGH(4)                                 MTXS0680
      EQUIVALENCE (HCAH(1),HCAH1),(HCBH(1),HCBH1),(HCGH(1),HCGH1)       MTXS0690
      COMMON/ADTNL/ U1,U2,U3,U4,V1,V2,V3,V4,W1,W2,W3,W4,                MTXS0700
     1              XIYP,SPHIC,CPHIC,APTCH1,APTCH2,APTCH3,APTCH4,       MTXS0710
     2              SLOPE1,SLOPE2,XTRA(300)                             MTXS0720
      DIMENSION UI(4),VI(4),WI(4)                                       MTXS0730
      EQUIVALENCE (UI(1),U1),(VI(1),V1),(WI(1),W1)                      MTXS0740
      DIMENSION APITCH(4)                                               MTXS0750
      EQUIVALENCE (APITCH(1),APTCH1)                                    MTXS0760
      COMMON /INSUS/ XIF,RHOF,TSF,PHIFO,PHIFOD,DEL40,DEL40D,ISUS,       MTXS0770
     1               AKDS,AKDS1,AKDS2,AKDS3,PHIRC(50),DTHF(50),DTHR(50),MTXS0780
     2               NCAMF,NCAMR,NDTHF,NDTHR                            MTXS0790
      COMMON /SUSCMP/ XMURO2,BXMRO2,XMTRO4,ZFO,TSFO2,RHOF2,RHFMUF,      MTXS0800
     1                RHF2MF,RF2MFI,RTF,RRTR,D3PD4,D3MD4,D43,DD3P4,     MTXS0810
     2                DD3M4,ZFD1RF,ZRD34,RFPF,RPF2M,WFMF,PHFP,PHIF2,    MTXS0820
     3                PHIFD2,RPHFD,ZFD1,ZFD2,ZRD4,TPF,SLOPE3,SLOPE4,    MTXS0830
     4                PHI3D,PHI4D,DTHF1,DTHF2,DTHR3,DTHR4,DTDD1,        MTXS0840
     5                DTDD2,DTDD3,DTDD4,FJF(4),SNPF                     MTXS0850
C                                                                       MTXS0860
      CALL CLEAR(DMATX(1,1),DMATX(10,11))                               MTXS0870
      DMATX(1,1) = SUMM                                                 MTXS0880
      DMATX(1,5) = GAM2                                                 MTXS0890
      DMATX(1,6) = RHOMUR*PHIR+RHFMUF*PHIF                              MTXS0900
      DMATX(2,2) = SUMM                                                 MTXS0910
      DMATX(2,4) = -GAM2                                                MTXS0920
      DMATX(2,6) = GAM1                                                 MTXS0930
      DMATX(2,8) = -RHFMUF                                              MTXS0940
      DMATX(2,10)= -RHOMUR                                              MTXS0950
      DMATX(3,3) = XMS                                                  MTXS0960
      DMATX(4,2) = -GAM3                                                MTXS0970
      DMATX(4,4) = XIX+XIXP                                             MTXS0980
      DMATX(4,6) = -XIXZ-XIXZP                                          MTXS0990
      DMATX(4,8) = RHFMUF*ZFD1                                          MTXS1000
```

```
      DMATX(4,10)= RHOMUR*ZRD3
      DMATX(5,1) = GAM2
      DMATX(5,5) = XIY+XIYP
      DMATX(5,6) = -XIYZP
      DMATX(6,1) = RHFMUF*PHIF+RHOMUR*PHIR
      DMATX(6,2) = GAM1
      DMATX(6,4) = -XIXZ-XIXZP-RHFMUF*A+RHOMUR*B
      DMATX(6,5) = -XIYZP
      DMATX(6,6) = XIZ+XIZP+XIR+XIF
      DMATX(6,8) = -RHFMUF*A
      DMATX(6,10)= BROMUR
      DMATX(7,3) = XMUF
      DMATX(7,4) = -RHFMUF*PHIF
      DMATX(7,5) = -AMUF
      DMATX(7,7) = XMUF
      DMATX(7,8) = -RHFMUF*PHIF
      DMATX(8,2) = -RHFMUF
      DMATX(8,3) = -RHFMUF*PHIF
      DMATX(8,4) = XIF+RHFMUF*ZFD1RF
      DMATX(8,5) = AMUF*RFPF
      DMATX(8,6) = -RHFMUF*A
      DMATX(8,7) = -RHFMUF*PHIF
      DMATX(8,8) = RF2MFI
      DMATX(9,3) = XMUR
      DMATX(9,4) = -RHOMUR*PHIR
      DMATX(9,5) = BMUR
      DMATX(9,9) = XMUR
      DMATX(9,10)= -RHOMUR*PHIR
      DMATX(10,2) = -RHOMUR
      DMATX(10,3) = -RHOMUR*PHIR
      DMATX(10,4) = XIR+RHOMUR*ZRD3R
      DMATX(10,5) = -BMUR*RPR
      DMATX(10,6) = BROMUR
      DMATX(10,9) = -RHOMUR*PHIR
      DMATX(10,10)= RHMR2I
      GCTSP = G*AMTX(3,2)
      GCTCP = G*AMTX(3,3)
      DMATX(1,11) = SUMM*(VR-WQ-GSTH)-GAM2*PR+(RHOMUR*PHIR+RHFMUF*PHIF)
     1              *PQ+GAM1*(Q2+R2)-GAM6*Q-2.0*(RHOMUR*RPHRD+RHFMUF*
     2               RPHFD)+SFXU+SFXS
      DMATX(2,11) = SUMM*(WP-UR+GCTSP)+GAM6*P-GAM1*PQ-GAM2*QR
     1              -RHOMUR*PHIR*(P2+R2+PHIRD2)-RHFMUF*PHIF*(P2+R2+
     2               PHIFD2)+SFYU+SFYS
      DMATX(3,11) = XMS*(UQ-VP+GCTCP)-SFZ1+SFZS
      DMATX(4,11) = GAM3*(UR-WP-GCTSP)+(XIXZ+XIXZP)*PQ-GAM7*P
     1              +(XIY-XIZ+XIXP)*QR-GAM4*(P2+R2)+RHOMUR*PHIR*ZRD3*
     2               PHIRD2+RHFMUF*PHIF*ZFD1*PHIFD2+SNPS+SNPU
      DMATX(5,11) = GAM2*(VR-WQ-GSTH)+XIXZ*(R2-P2)+(XIZ-XIX-XIYP)*PR
     1              -GAM7*Q-2.0*Q*(RHOF*WFMF+RHO*TG61)+(XIXZP-BROMUR
     2              +RHOF*AMUF)*(Q2+R2)-XIYZP*PQ-2.0*RHOMUR*ZRD3R*RPHRD
     3              -2.0*RHFMUF*ZFD1RF*RPHFD+SNTU+SNTS
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```
      DMATX(6,11) = GAM1*(WP-UR+GCTSP)+(XIX-XIY-GAM5)*PQ
     1            -(XIXZ+XIXZP-BROMUR+AMUF*RHOF)*QR+GAM8*Q+XIYZP*PR
     2            +GAM9*P+XMUR*RPR*(VR-WQ-2.0*RHO*RPHRD-B*(Q2-P2
     3           -PHIRD2)-GSTH)+XMUF*RFPF*(VR-WQ-2.0*RHOF*RPHFD
     4            +A*(Q2-P2-PHIFD2)-GSTH)+SNPSS+SNPSU
      DMATX(7,11) = XMUF*(UQ-VP+RHOF*PHIFD2+2.0*P*RHOF*PHIFD-A*PR
     1            +RFPF*QR+ZFD1RF*(P2+Q2)+GCTCP)
     2            +FZU(1)+FZU(2)+SI(1)+SI(2)
      DMATX(8,11) = RHFMUF*(UR-WP-2.0*P*DEL1D+2.0*P*RFPF*PHIFD+A*PQ
     1            +RFPF*(P2+R2)+ZFD1RF*QR-GCTH*SIN(PHIT+PHIF))
     2            +RHFMUF*PHIF*(VP-UQ-2.0*P*RHOF*PHIFD+A*PR
     3            -ZFD1RF*(P2+Q2))-XIF*PHIF*(R2-Q2)-XIF*QR+SNPF
      DMATX(9,11) = XMUR*(UQ-VP+RHO*PHIRD2+2.0*P*RHO*PHIRD+B*PR
     1            +RPR*QR+ZRD3R*(P2+Q2)+GCTCP)
     2            +FZU(3)+FZU(4)+SI(3)+SI(4)
      DMATX(10,11)= RHOMUR*(UR-WP-2.0*P*DEL3D+2.0*P*RPR*PHIRD-B*PQ
     1            +RPR*(P2+R2)+ZRD3R*QR-GCTH*SIN(PHIT+PHIR))
     2            +RHOMUR*PHIR*(VP-UQ-2.0*P*RHO*PHIRD-B*PR
     3            -ZRD3R*(P2+Q2))-XIR*PHIR*(R2-Q2)-XIR*QR+SNPR
      RETURN
      END
```

```
      SUBROUTINE NLDFL
C              HVOSM-RD2 VERSION
C              REVISED OCTOBER 1975   CALSPAN CORPORATION
      COMMON /INTG/NEQ,T,DT,VAR(50),DER(50)
      EQUIVALENCE (U,VAR(1)),(V,VAR(2)),(W,VAR(3)),(P,VAR(4)),(Q,VAR(5))
     1           ,(R,VAR(6)),(DEL1,VAR(7)),(DEL1D,VAR(8)),(DEL2,VAR(9)),
     2            (DEL2D,VAR(10)),(DEL3,VAR(11)),(DEL3D,VAR(12)),
     3            (PHIR,VAR(13)),(PHIRD,VAR(14)),(THETTP,VAR(15)),
     4            (PHITP,VAR(16)),(PSITP,VAR(17)),(XCP,VAR(18)),
     5            (YCP,VAR(19)),(ZCP,VAR(20)),(PSIFI,VAR(21)),
     6            (PSIFID,VAR(22))
      EQUIVALENCE (DU,DER(1)),(DV,DER(2)),(DW,DER(3)),(DP,DER(4)),
     1            (DQ,DER(5)),(DR,DER(6)),(DDEL1,DER(7)),(DDEL1D,DER(8))
     2           ,(DDEL2,DER(9)),(DDEL2D,DER(10)),(DDEL3,DER(11)),
     3            (DDEL3D,DER(12)),(DPHIR,DER(13)),(DPHIRD,DER(14)),
     4            (DTHTTP,DER(15)),(DPHITP,DER(16)),(DPSITP,DER(17)),
     5            (DXCP,DER(18)),(DYCP,DER(19)),(DZCP,DER(20)),
     6            (DPSIFI,DER(21)),(DDPSFI,DER(22))
      EQUIVALENCE (VAR(9),PHIF),(VAR(10),PHIFD),(DER(9),DPHIF),
     1            (DER(10),DPHIFD)
      EQUIVALENCE (VAR(13),DEL4),(VAR(14),DEL4D),(DER(13),DDEL4),
     1            (DER(14),DDEL4D)
      COMMON /INPT2/ YBPO,ZBTP,ZBBP,XVF,XVR,YV,ZVT,ZVB,AKV,SIGR(11),
     1               SET,CONS,AMUB,EPSV,EPSB,XM,EPST,DDD,INDB,DELYBP,
     2               DELTB,XINPT(100)
      COMMON/BARIER/FN,IBHIT,JBHIT,XCPNP(3),YCPNP(3),ZCPNP(3),XCPN(3),
     1              YCPN(3),ZCPN(3),AA1(17),BB1(17),CC1(17),RR1(17),
     2              AA2(17),BB2(17),CC2(17),RR2(17),CAB,CBB,CGB,CABT,
     3              CBBT,CGBT,RB,XBT,YBT,ZBT,XBB,YBB,ZBB,RR2P(17),
     4              YBPT,XNN(17),YNN(17),ZNN(17),XMTX(3,4),IDPT(17),IPT
     5              ,ININD,UNP(17),VNP(17),WNP(17),VMAX(4),I1,I2,I3,I4,
     6              XCPTP,YCPTP,ZCPTP,XCPBP,YCPBP,ZCPBP,YCPMP,AINTI,
     7              AINTP,SXR,SYR,SZR,SDEN,XRI,YRI,ZRI,FRICT,DELBB,VTAN,
     8              FNP,FB,URP,VRP,WRP,EPSL,XLDP,DELX,VL,NCYC,EEE,ENRGY,
     9              NSEG,YBPTP,PCAB,PCBB,PCGB,PPRB,CAB1,CBB1,CGB1,
     A              RB1,NUNLD,NLDCTR,VDEF,PVDEF,PSZR,XF,DELBBP,
     B              SWORK,SPENGY,DISS,IPLN,ILOAD
      DIMENSION INDXPT(4)
      EQUIVALENCE (INDXPT(1),I1)
      REAL*8 ALIM1/'UPPER'/,ALIM2/'LOWER'/,XLIM
    1 XLP = VMAX11
      VSIGN = 0.0
      VMAX11 = (YBPT-YBPTP)/DT
      VMAX(1) = VMAX11
      IF(VMAX(1))200,201,202
  200 VSIGN = -1.0
      GO TO 203
  201 VSIGN = 0.0
      GO TO 300
```

```
202 VSIGN = 1.0                                                         NLDF0500
203 XL = DELBB                                                          NLDF0510
    EPSP = EPSL                                                         NLDF0520
    XVLP = VL                                                           NLDF0530
  2 VL = XL-EPSL                                                        NLDF0540
    IF(VL.GT.0.0) GO TO 3                                               NLDF0550
    FB = 0.0                                                            NLDF0560
    GO TO 13                                                            NLDF0570
  3 IF(VMAX11.LT.0.0) GO TO 9                                           NLDF0580
    IF(ILOAD.EQ.1.AND.VSIGN.EQ.1.0)GO TO 6                              NLDF0590
    IF(ILOAD.EQ.1.AND.VSIGN.NE.1.0)GO TO 10                             NLDF0600
    FB = SIGR(1)                                                        NLDF0610
    XX = VL                                                             NLDF0620
    YY = VMAX(1)                                                        NLDF0630
  4 DO 5  I=2,6                                                         NLDF0640
    J = I+5                                                             NLDF0650
    FB = FB+SIGR(I)*XX+SIGR(J)*YY                                       NLDF0660
    XX = XX*VL                                                          NLDF0670
    YY = YY*VMAX(1)                                                     NLDF0680
  5 CONTINUE                                                            NLDF0690
    ILOAD = 0                                                           NLDF0700
    GO TO 13                                                            NLDF0710
  6 IF(XF.GT.0.0)GO TO 7                                                NLDF0720
    EPSL = SET*DELX+EPSL                                                NLDF0730
    DELX = 0.0                                                          NLDF0740
    GO TO 8                                                             NLDF0750
  7 XX = VL                                                             NLDF0760
    YY = (SET*DELX+VL)/2.0                                              NLDF0770
    CALL POLY(SIGR(1),SIGR(2),XX,YY,FB)                                 NLDF0780
    EPSL = YY+EPSL                                                      NLDF0790
  8 ILOAD = 0                                                           NLDF0800
    NCYC = NCYC+1                                                       NLDF0810
    GO TO 2                                                             NLDF0820
  9 IF(ILOAD.EQ.0)GO TO 212                                             NLDF0830
    IF(VSIGN.NE.1.0)GO TO 10                                            NLDF0840
212 DELX = VL                                                           NLDF0850
    FUM = FB                                                            NLDF0860
    GI1 = SET-1.0                                                       NLDF0870
    GI3 = GI1**3*DELX                                                   NLDF0880
    FDL = FUM*DELX                                                      NLDF0890
    EEE = EEE - ENGY                                                    NLDF0900
    XVLP = VL                                                           NLDF0910
 90 CD0 = SET*(FDL*(SET**2+SET-2.0)+6.0*EEE)/GI3                        NLDF0920
    CD1 = -2.0*(FDL*(2.0*SET+1.0)*GI1+3.0*EEE*(SET+1.0))/(DELX*GI3)     NLDF0930
    CD2 = 3.0*(FDL*GI1+2.0*EEE)/(DELX**2*GI3)                           NLDF0940
    ILOAD = 1                                                           NLDF0950
    TMP = FB*DELX*(1.0-SET)                                             NLDF0960
    IF(TMP.LE.3.0*EEE) GO TO 91                                         NLDF0970
    RTMP = 1.005*CONS*TMP/(3.0*EEE)                                     NLDF0980
    ETMP = 1.005*TMP/3.0                                                NLDF0990
    XLIM = ALIM2                                                        NLDF1000
```

```
      GO TO 92
   91 IF(TMP.GE.2.0*EEE) GO TO 10
      RTMP = .995*CONS*TMP/(2.0*EEE)
      ETMP = .995*TMP/2.0
      XLIM = ALIM1
   92 IF(NCYC.GT.0) GO TO 93
      TMPR = CONS
      CONS = RTMP
      EEE = ETMP
      WRITE(6,1000) TMPR,CONS,T
 1000 FORMAT(19HOCONS CHANGED FROM ,E12.5,4H TO ,E12.5,8H AT T = ,F9.6)
      GO TO 90
   93 EEE = ETMP
      WRITE(6,1001) XLIM,T
 1001 FORMAT(27HOCONSERVED ENERGY RESET TO ,A6,14H LIMIT AT T = ,F9.6)
      GO TO 90
   10 IF(VL-SET*DELX.GT.0.0) GO TO 12
   11 FB = 0.0
      DELBB = EPSL+SET*DELX
      GO TO 13
   12 FB = CD0+CD1*VL+CD2*VL**2
      FB = AMAX1(FB,0.0)
   13 ENGY = (XF+FB)*(VL+EPSL-EPSP-XVLP)/2.0
      ENRGY = ENRGY+ENGY
      IF(VMAX11.LT.0.0) GO TO 14
      EPL = ENGY
      EMI = 0.0
      GO TO 15
   14 EMI = ENGY
      EPL = 0.0
   15 EEE = EEE+CONS*EPL+EMI
  300 XF = FB
      RETURN
      ENTRY NLDFRC
   16 WL = DELBB-EPSL
      IF(ILOAD.NE.0)GO TO 19
      XX = WL
      YY = VMAX(1)
      FB = SIGR(1)
   17 DO 18 I=2,6
      J = I+5
      FB = FB+SIGR(I)*XX+SIGR(J)*YY
      XX = XX*WL
      YY = YY*VMAX(1)
   18 CONTINUE
      GO TO 20
   19 IF(WL-SET*DELX.GT.0.0)GO TO 100
      FB = 0.0
      RETURN
  100 FB = CD0+CD1*WL+CD2*WL**2
   20 FB = AMAX1(FB,0.0)
```

```
      RETURN                                                          NLDF1520
      END                                                             NLDF1530
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      SUBROUTINE OUTPUT(IND)
C              HVOSM-RD2 VERSION
C              REVISED OCTOBER 1975   CALSPAN CORPORATION
C              HVOSM-RD2 VERSION
C              REVISED OCTOBER 1975  CALSPAN CORPORATION
      COMMON/HEAD/ VHED(20),CHED(20),GHED(20),SHED(20),THED(20),
     1             NPAGE(20)
      COMMON/INPT/PHIO,THETAO,PSIO,PO,QO,RO,XCOP,YCOP,ZCOP,UO,VO,WO,
     1            A,B,DEL10,DEL20,DEL30,PHIRO,DEL10D,DEL20D,DEL30D,
     2            PHIROD,TF,TR,ZF,ZR,RHO,AKRS,XMUR,
     3            XMS,XMUF,XIX,XIY,XIZ,XIXZ,CF,AKF,XLAMF,OMEGF,CFP,EPSF,
     4            RF,CR,AKR,XLAMR,OMEGR,CRP,EPSR,RR,TS,THMAX,DTCOMP,TO,
     5            T1,DTCMP1,DTPRNT,MODE,EBAR,EM,AAA,HMAX,HMIN,BET,G,
     6            HED(36),DADE(3),XIR,X1,Y1,Z1,X2,Y2,Z2,PHIC(50),DELB,
     7            DELE,DDEL,NDEL,PSIF(50),TQF(50),TQR(50),TB,TE,TINCR,
     8            NZTAB,NZ5,XBDRY(4,5),PSBDRY(4,5),YBDRY(2,5),NBX(5),
     9            NBY(5),NTBL1,NTBL2,NTBL3,ZGP(21,21,5)
      COMMON/INPT/XB(5),XE(5),XINCR(5),NX(5),YB(5),YE(5),YINCR(5),NY(5),
     1         XXZGP5(21),YYZGP5(21),AMUG(5),PSBDRO(4,5),UVWMIN,PQRMIN
      COMMON /INTG/NEQ,T,DT,VAR(50),DER(50)
      EQUIVALENCE (U,VAR(1)),(V,VAR(2)),(W,VAR(3)),(P,VAR(4)),(Q,VAR(5))
     1           ,(R,VAR(6)),(DEL1,VAR(7)),(DEL1D,VAR(8)),(DEL2,VAR(9)),
     2            (DEL2D,VAR(10)),(DEL3,VAR(11)),(DEL3D,VAR(12)),
     3            (PHIR,VAR(13)),(PHIRD,VAR(14)),(THETTP,VAR(15)),
     4            (PHITP,VAR(16)),(PSITP,VAR(17)),(XCP,VAR(18)),
     5            (YCP,VAR(19)),(ZCP,VAR(20)),(PSIFI,VAR(21)),
     6            (PSIFID,VAR(22))
      EQUIVALENCE (DU,DER(1)),(DV,DER(2)),(DW,DER(3)),(DP,DER(4)),
     1            (DQ,DER(5)),(DR,DER(6)),(DDEL1,DER(7)),(DDEL1D,DER(8))
     2           ,(DDEL2,DER(9)),(DDEL2D,DER(10)),(DDEL3,DER(11)),
     3            (DDEL3D,DER(12)),(DPHIR,DER(13)),(DPHIRD,DER(14)),
     4            (DTHTTP,DER(15)),(DPHITP,DER(16)),(DPSITP,DER(17)),
     5            (DXCP,DER(18)),(DYCP,DER(19)),(DZCP,DER(20)),
     6            (DPSIFI,DER(21)),(DDPSFI,DER(22))
      EQUIVALENCE (VAR(9),PHIF),(VAR(10),PHIFD),(DER(9),DPHIF),
     1            (DER(10),DPHIFD)
      EQUIVALENCE (VAR(13),DEL4),(VAR(14),DEL4D),(DER(13),DDEL4),
     1            (DER(14),DDEL4D)
      COMMON /DIMV/X1P,X2P,X3P,X4P,Y1P,Y2P,Y3P,Y4P,Z1P,Z2P,Z3P,Z4P,PHI1,
     1             PHI2,PHI3,PHI4,PSI1,PSI2,PSI3,PSI4,CAYW(4),CBYW(4),
     2             CGYW(4),ZPGI(4),THGI(4),PHGI(4),CPG(4),SPG(4),CTG(4),
     3             STG(4),CAGZ(4),CBGZ(4),CGGZ(4),D1(4),D2(4),D3(4),
     4             XLM1(4),XLM2(4),XLM3(4),AMTX(3,3),CMTX(3,4),XGPP(4),
     5             YGPP(4),ZGPP(4),DMATX(10,11),DELTA(4),CAR(4),CBR(4),
     6             CGR(4),FR(4),HI(4),FC(4),TI(4),AX(4),BX(4),CX(4),
     7             CTXG(4),UG(4),STXG(4),AY(4),BY(4),CY(4),CPYG(4),
     8             SPYG(4),VG(4),PSIIP(4),PHICI(4),CAC(4),CBC(4),CGC(4),
     9             FCXU(4),FCYU(4),FCZU(4),FS(4),CAXW(4),CBXW(4),CGXW(4)
      COMMON /DIMV/AS(4),BS(4),CS(4),CAS(4),CBS(4),CGS(4),BETP(4),
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1           BETBR(4),FSXU(4),FSYU(4),FSZU(4),FRXU(4),FRYU(4),        OUTP0500
2           FRZU(4),FXU(4),FYU(4),FZU(4),SI(4),F1FI(2),F1RI(2),      OUTP0510
3           F2FI(2),F2RI(2),CAH(4),CBH(4),CGH(4)                     OUTP0520
 DIMENSION XP(4),YP(4),ZP(4),PHII(4),PSII(4)                         OUTP0530
 EQUIVALENCE (XP(1),X1P),(YP(1),Y1P),(ZP(1),Z1P),(PHII(1),PHI1),     OUTP0540
1           (PSII(1),PSI1)                                           OUTP0550
 COMMON /COMP/SUMM,THETN,PHIN,PSIN,PI,RAD,GAM1,GAM2,GAM3,GAM4,GAM5,OUTP0560
1          GAM6,GAM7,GAM8,GAM9,THETT,PHIT,PSIT,ZRO,TRO2,             OUTP0570
2           TFO2,TIZ,RHO2,RHOMUR,AMUF,BMUR,ZPR,TM4,RHMR2,AO2APB,     OUTP0580
3           BO2APB,RFTF,TSO2,RRTS,BROMUR,XMUFO2,AXMFO2,XMTFO4,       OUTP0590
4           XIZR,RTR,RHMR2I,XIXP,XIZP,XIXZP,XIYZP,D1PD2,D1MD2,       OUTP0600
5           ZRD3,ZRD3R,ZFD3R,ZFD12,TIZ2,TG61,DD1P2,DD1M2,RPR,PHRPOUTP0610
6          ,TANTP,SPHTP,CPHTP,SECTP,SFXS,SFYS,SFZS,SNPS,SNTS,        OUTP0620
7           SNPSS,TPR,CAY,CBY,CGY,CAX,CBX,CGX,SFYU,SFXU,SFYUF,       OUTP0630
8           SFYUR,SFZU,COSTH,SINTH,COSPS,SINPS,COSPH,SINPH,ANG1,     OUTP0640
9           ANG2,CPHI,SPHI,CPSI,SPSI,P1,P7,P3,P4,P5,P6,TX,TY,TZ      OUTP0650
 COMMON /COMP/TRH,DISTX,DISTY,DISTD,DISTS,D21,ZETA4,ZETA4D,ZETA3,    OUTP0660
1           ZETA3D,SFZ1,SNPU,SNTU,HCGH1,HCGH2,HCGH3,HCGH4,TERM1,     OUTP0670
2           TERM2,SNPSU,SNPR,HCBH1,HCBH2,HCBH3,HCBH4,HCAH1,HCAH2,OUTP0680
3           HCAH3,HCAH4,UQ,WP,UR,QR,VP,PR,P2,Q2,R2,VR,WQ,PQ,PHIR2OUTP0690
4          ,PHIRD2,RPHRD,GCTH,GSTH,GCTSP,GCTCP,XXX,YYY,IX,IY,XX1,OUTP0700
5           XX2,YY1,YY2,THG1,THG2,PHG1,PHG2,ZZ1,ZZ2,LLL              OUTP0710
 DIMENSION HCAH(4),HCBH(4),HCGH(4)                                   OUTP0720
 EQUIVALENCE (HCAH(1),HCAH1),(HCBH(1),HCBH1),(HCGH(1),HCGH1)         OUTP0730
 COMMON /COMPN/ FRSP(4),FRCP(4),ICBHIT,JCBHIT,                       OUTP0740
1             DPSINT,TANPC1,TANPC2,PHIC1R,PHIC2R,AMUCMP,PHI1D,       OUTP0750
2             PHI2D,LCB1(4),LCB2(4),IHIT,AJMTX(3,3),BMTX(3,3),       OUTP0760
3             SFRX(4),SFRY(4),SFRZ(4),T1PSI,T2PSI,XMUGI(4)           OUTP0770
 LOGICAL LCB1,LCB2                                                   OUTP0780
 COMMON/ADTNL/ U1,U2,U3,U4,V1,V2,V3,V4,W1,W2,W3,W4,                  OUTP0790
1            XIYP,SPHIC,CPHIC,APTCH1,APTCH2,APTCH3,APTCH4,           OUTP0800
2            SLOPE1,SLOPE2,XTRA(300)                                 OUTP0810
 DIMENSION UI(4),VI(4),WI(4)                                         OUTP0820
 EQUIVALENCE (UI(1),U1),(VI(1),V1),(WI(1),W1)                        OUTP0830
 DIMENSION APITCH(4)                                                 OUTP0840
 EQUIVALENCE (APITCH(1),APTCH1)                                      OUTP0850
 COMMON/BARIER/FN,IBHIT,JBHIT,XCPNP(3),YCPNP(3),ZCPNP(3),XCPN(3),    OUTP0860
1            YCPN(3),ZCPN(3),AA1(17),BB1(17),CC1(17),RR1(17),        OUTP0870
2            AA2(17),BB2(17),CC2(17),RR2(17),CAB,CBB,CGB,CABT,       OUTP0880
3            CBBT,CGBT,RB,XBT,YBT,ZBT,XBB,YBB,ZBB,RR2P(17),          OUTP0890
4            YBPT,XNN(17),YNN(17),ZNN(17),XMTX(3,4),IDPT(17),IPT     OUTP0900
5            ,ININD,UNP(17),VNP(17),WNP(17),VMAX(4),I1,I2,I3,I4,     OUTP0910
6            XCPTP,YCPTP,ZCPTP,XCPBP,YCPBP,ZCPBP,YCPMP,AINTI,        OUTP0920
7            AINTP,SXR,SYR,SZR,SDEN,XRI,YRI,ZRI,FRICT,DELBB,VTAN,OUTP0930
8            FNP,FB,URP,VRP,WRP,EPSL,XLDP,DELX,VL,NCYC,EEE,ENRGY,OUTP0940
9            NSEG,YBPTP,PCAB,PCBB,PCGB,PPRB,CAB1,CBB1,CGB1,          OUTP0950
A            RB1,NUNLD,NLDCTR,VDEF,PVDEF,PSZR,XF,DELBBP,             OUTP0960
B            SWORK,SPENGY,DISS,IPLN,ILOAD                            OUTP0970
 DIMENSION INDXPT(4)                                                 OUTP0980
 EQUIVALENCE (INDXPT(1),I1)                                          OUTP0990
 COMMON /INSUS/ XIF,RHOF,TSF,PHIFO,PHIFOD,DEL40,DEL40D,ISUS,         OUTP1000
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     1               AKDS,AKDS1,AKDS2,AKDS3,PHIRC(50),DTHF(50),DTHR(50),OUTP1010
     2               NCAMF,NCAMR,NDTHF,NDTHR                              OUTP1020
      COMMON /SUSCMP/ XMURO2,BXMRO2,XMTRO4,ZFO,TSFO2,RHOF2,RHFMUF,        OUTP1030
     1                RHF2MF,RF2MFI,RTF,RRTR,D3PD4,D3MD4,D43,DD3P4,        OUTP1040
     2                DD3M4,ZFD1RF,ZRD34,RFPF,RPF2M,WFMF,PHFP,PHIF2,       OUTP1050
     3                PHIFD2,RPHFD,ZFD1,ZFD2,ZRD4,TPF,SLOPE3,SLOPE4,       OUTP1060
     4                PHI3D,PHI4D,DTHF1,DTHF2,DTHR3,DTHR4,DTDD1,           OUTP1070
     5                DTDD2,DTDD3,DTDD4,FJF(4),SNPF                        OUTP1080
      COMMON/BARSTR/XSTIO(3),YSTIO(3),ZSTIO(3),XSTI(3),YSTI(3),           OUTP1090
     1              ZSTI(3),YSTIPO(3),XSTIP(3),YSTIP(3),ZSTIP(3),          OUTP1100
     2              FNSTI(3),AKST(3)                                       OUTP1110
      DIMENSION ASTR(4),SLPANG(4)                                         OUTP1120
      DIMENSION HDEF(3)                                                   OUTP1130
      DATA STAR,BLNK/1H*,1H /                                             OUTP1140
      DATA LPP/50/                                                        OUTP1150
      DATA TTTTTT/-9999.0/                                                OUTP1160
      IF(IND.NE.0) GO TO 400                                              OUTP1170
      LINES = 0                                                           OUTP1180
      RETURN                                                              OUTP1190
  400 LINES = LINES+1                                                     OUTP1200
      IF(MOD(LINES,LPP).NE.1) GO TO 500                                   OUTP1210
      XPAGE = 0.01*(LINES+LPP-1)/LPP                                      OUTP1220
      NT = 10                                                             OUTP1230
      IS1 = ISUS+1                                                        OUTP1240
      DO 410 J=1,19                                                       OUTP1250
      IF(NPAGE(J).EQ.0) GO TO 410                                         OUTP1260
      NT = NT+1                                                           OUTP1270
      PAGE = NT+XPAGE                                                     OUTP1280
      WRITE(NT,1000) (HED(I),I=1,18),DADE(1),DADE(2),                     OUTP1290
     1     (VHED(I),I=1,10),(THED(I),I=1,10),(CHED(I),I=1,10),            OUTP1300
     2      (GHED(I),I=1,10),(SHED(I),I=1,10),PAGE                        OUTP1310
 1000 FORMAT(1H1,19X,18A4,20X,2A4 / 5X,3(10A4) / 5X,2(10A4),              OUTP1320
     1       22X,4HPAGE,1X,F8.2  /  )                                     OUTP1330
      GO TO(111,112,113,114,115,116,117,118,119,120,121,122,123,124,      OUTP1340
     *      125,126,127,128,129),J                                        OUTP1350
C  POSSIBLE ERROR MESSAGE                                                 OUTP1360
      GO TO 410                                                           OUTP1370
  111 WRITE(NT,1100)                                                      OUTP1380
 1100 FORMAT(1H0,48X,23HS P R U N G    M A S S   /                        OUTP1390
     A62H  TIME   |           POSITION (FEET)           |      VELOCITY ( OUTP1400
     B62HFT/SEC)            |               ACCELERATION (G-UNITS)        OUTP1410
     C 6H      |   /                                                      OUTP1420
     D62H   SEC   |      XC'    |      YC'    |     ZC'     |  FORWARD  | LA OUTP1430
     E62HTERAL  | VERTICAL |    LONG.   |     LAT.  |      VERT.   |  RESU OUTP1440
     F 6HLT.  |   /)                                                      OUTP1450
      GO TO 410                                                           OUTP1460
  112 IF(ISUS.EQ.1) GO TO 1121                                            OUTP1470
      WRITE(NT,1200)                                                      OUTP1480
 1200 FORMAT(                                                             OUTP1490
     A62H0        |                                 S P R U N G   M A S S OUTP1500
     B62H                    |  SIDESLIP |    COURSE |FRONT STEER| REAR   OUTP1510
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   C 6HSTEER|  /
   D62H  TIME   |   ANGULAR VELOCITIES (DEG/SEC)     |      ORIENTATIO
   E62HN (DEGREES)          |    ANGLE  |    ANGLE   |    ANGLE  |    AN
   F 6HGLE  |  /
   G62H   SEC   |     P     |     Q     |     R     |    ROLL   |   P
   H62HITCH   |     YAW   |    DEG    |    DEG    |    DEG    |    D
   I 6HEG    |  /)
    GO TO 410
1121 WRITE(NT,1201)
1201 FORMAT(
   A62HO        |                          S P R U N G   M A S S
   B62H                     |  SIDESLIP |   COURSE |FR.STEER|RR STEER|
   C 9HLR STEER|  /
   D62H  TIME   |   ANGULAR VELOCITIES (DEG/SEC)     |      ORIENTATIO
   E62HN (DEGREES)          |    ANGLE  |    ANGLE   | ANGLE |  ANGLE |
   F 9H  ANGLE |  /
   G62H   SEC   |     P     |     Q     |     R     |    ROLL   |   P
   H62HITCH   |     YAW   |    DEG    |    DEG    |  DEG  |   DEG  |
   I 9H  DEG  |  /   )
    GO TO 410
 113 WRITE(NT,1300)
1300 FORMAT(
   A62HO TIME   |       WHEEL RIDE DISPLACEMENTS (INCHES)         |
   B44H     WHEEL RIDE VELOCITIES (IN/SEC)         |   /
   C62H   SEC   |      RF    |     LF    |      RR    |      LR    |
   D44H  RF    |      LF    |     RR    |      LR    |   /)
    GO TO 410
 114 GO TO(1140,1141,1142),IS1
1140 WRITE(NT,1400)
1400 FORMAT(55HO          |              SPRUNG MASS              |   WHEEL
   A62HRIDE ACCEL  |     REAR ROLL CENTER RIDE        |     REAR AXLE A
   B15HNGULAR          |  /
   C62H  TIME   | ANGULAR ACCELERATIONS (DEG/SEC**2)|    (IN/SEC**2)
   D62H       | DEFL   | VELOCITY |ACCELERATION|  DEFL   | VELOCITY |  A
   E 9HCCEL   |   /
   F62H   SEC   |    DP/DT |     DQ/DT |     DR/DT |       RF   |
   G62H LF   | INCHES |   IN/SEC | IN/SEC**2   |   DEG   |  DEG/SEC |DEG
   H 8H/SEC**2|   /)
    GO TO 410
1141 WRITE(NT,1401)
1401 FORMAT(1HO,
   A62H         |        SPRUNG MASS             |       WHEEL RIDE ACCE
   B14HL            | /
   C62H   TIME   | ANGULAR ACCEL. (DEG/SEC**2) |          (IN/SEC**2)
   D15H             | /
   E62H     SEC   |   DP/DT |   DQ/DT |   DR/DT |     RF |     LF |
   F15H  RR |     LR | / )
    GO TO 410
1142 WRITE(NT,1402)
1402 FORMAT(
   A62HO        |        SPRUNG MASS             |    FRONT ROLL CENTER
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    B62H     |     REAR ROLL CENTER      | FR. AXLE ANGULAR|REAR AXLE A OUTP2030
    C 7HNGULAR|   /                                                      OUTP2040
    D62H   TIME   | ANGULAR ACCEL. (DEG/SEC**2) |  DEFL  |VELOCITY|  A OUTP2050
    E62HCCEL |  DEFL  |VELOCITY|  ACCEL |VELOCITY|  ACCEL |VELOCITY|   OUTP2060
    F 7HACCEL |   /                                                      OUTP2070
    G62H    SEC    |   DP/DT |   DQ/DT |   DR/DT | INCHES | IN/SEC | IN OUTP2080
    H62H/SEC2| INCHES | IN/SEC | IN/SEC2| DEG/SEC|DEG/SEC2| DEG/SEC|DE OUTP2090
    I 7HG/SEC2|   /    )                                                 OUTP2100
     GO TO 410                                                           OUTP2110
 115 WRITE(NT,1500)                                                      OUTP2120
1500 FORMAT(1H0,8X,48H| STEER FRIC| STEER STOP|    STEER  |    STEER    OUTP2130
    A 1H|  /                                                             OUTP2140
    B59H  TIME    |   TORQUE   |   TORQUE   |     VEL    |   ACCEL   |  / OUTP2150
    C59H   SEC    |    LB-IN   |    LB-IN   |   DEG/SEC | DEG/SEC**2|  /) OUTP2160
     GO TO 410                                                           OUTP2170
 116 GO TO(1160,1161,1162),IS1                                           OUTP2180
1160 WRITE(NT,1600)                                                      OUTP2190
1600 FORMAT(                                                             OUTP2200
    A62H0 TIME    |    STEER ANGLE IN GROUND PLANE (DEG)          |   C OUTP2210
    B62HAMBER ANGLE RELATIVE TO GROUND PLANE (DEG) |  CAMBER ANGLE (DE OUTP2220
    C 6HG)   |   /                                                       OUTP2230
    D62H   SEC    |      RF    |      LF    |      RR    |      LR    |   OUTP2240
    E62H  RF    |      LF    |      RR    |      LR    |      RF    |     OUTP2250
    F 6HLF    |   /)                                                     OUTP2260
     GO TO 410                                                           OUTP2270
1161 WRITE(NT,1601)                                                      OUTP2280
1601 FORMAT(                                                             OUTP2290
    A62H0 TIME    |    STEER ANGLE IN GROUND PLANE (DEG)          |   C OUTP2300
    B62HAMBER ANGLE RELATIVE TO GROUND PLANE (DEG) |    CAMBER ANGLE ( OUTP2310
    C 9HDEG)    |    /                                                   OUTP2320
    D62H   SEC    |      RF    |      LF    |      RR    |      LR    |   OUTP2330
    E62H  RF    |      LF    |      RR    |      LR    |  RF |   LF |   R OUTP2340
    F 9HR |  LR |    /  )                                                OUTP2350
     GO TO 410                                                           OUTP2360
1162 WRITE(NT,1602)                                                      OUTP2370
1602 FORMAT(                                                             OUTP2380
    A62H0 TIME    |    STEER ANGLE IN GROUND PLANE (DEG)          |   C OUTP2390
    B62HAMBER ANGLE RELATIVE TO GROUND PLANE (DEG) | AXLE ROLL ANGLE ( OUTP2400
    C 6HDEG) |   /                                                       OUTP2410
    D62H   SEC    |      RF    |      LF    |      RR    |      LR    |   OUTP2420
    E62H  RF    |      LF    |      RR    |      LR    | FRONT-PHIF| REAR- OUTP2430
    F 6HPHIR |   / )                                                     OUTP2440
     GO TO 410                                                           OUTP2450
 117 WRITE(NT,1700)                                                      OUTP2460
1700 FORMAT(                                                             OUTP2470
    A62H0         |     LONGITUDINAL WHEEL CENTER VELOCITY          |     OUTP2480
    B44H    LATERAL CONTACT POINT VELOCITY          |    /               OUTP2490
    C62H  TIME    |      PARALLEL TO GROUND PLANE (FT/SEC)          |     OUTP2500
    D44H   PARALLEL TO GROUND PLANE (FT/SEC)        |    /               OUTP2510
    E62H   SEC    |      RF    |      LF    |      RR    |      LR    |   OUTP2520
    F44H  RF    |      LF    |      RR    [      LR    |    /)           OUTP2530
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      GO TO 410                                                           OUTP2540
  118 WRITE(NT,1800)                                                      OUTP2550
 1800 FORMAT(                                                             OUTP2560
     A58H0 TIME   |   TIRE CONTACT POINT ELEVATION (INCHES)        | /    OUTP2570
     B58H   SEC   |       RF    |      LF     |       RR    |      LR   | /)  OUTP2580
      GO TO 410                                                           OUTP2590
  119 WRITE(NT,1900)                                                      OUTP2600
 1900 FORMAT(                                                             OUTP2610
     A62H0 TIME   |          TOTAL SUSPENSION FORCE (LBS)             |   OUTP2620
     B44H      SUSPENSION ANTI-PITCH FORCE (LBS)      |    /              OUTP2630
     C62H   SEC   |       RF    |      LF     |       RR    |      LR   |  OUTP2640
     D44H  RF    |       LF    |       RR    |       LR    |    /)        OUTP2650
      GO TO 410                                                           OUTP2660
  120 WRITE(NT,2000)                                                      OUTP2670
 2000 FORMAT(                                                             OUTP2680
     A62H0 TIME   |        SUSPENSION DAMPING FORCE (LBS)             |   OUTP2690
     B44H        SUSPENSION SPRING FORCE (LBS)        |      /            OUTP2700
     C62H   SEC   |       RF    |      LF     |       RR    |      LR   |  OUTP2710
     D44H  RF    |       LF    |       RR    |       LR    |    /)        OUTP2720
      GO TO 410                                                           OUTP2730
  121 WRITE(NT,2100)                                                      OUTP2740
 2100 FORMAT(                                                             OUTP2750
     A62H0 TIME   |          RADIAL TIRE FORCES (LBS)                 |   OUTP2760
     B44H        ROLLING RADIUS (INCHES)              |   /               OUTP2770
     C62H   SEC   |       RF    |      LF     |       RR    |      LR   |  OUTP2780
     D44H  RF    |       LF    |       RR    |       LR    |   /)         OUTP2790
      GO TO 410                                                           OUTP2800
  122 WRITE(NT,2200)                                                      OUTP2810
 2200 FORMAT(                                                             OUTP2820
     A62H0 TIME   |          TIRE NORMAL FORCE (LBS)             |        OUTP2830
     B62H TIRE SIDE FORCE (LBS)              |          SLIP ANGLE (DEG)  OUTP2840
     C 6H      |    /                                                     OUTP2850
     D62H  SEC     |       RF   |       LF   |       RR   |      LR   |       RF OUTP2860
     E62H  |        LF   |        RR   |       LR   |   RF   |   LF   |   RR   |  OUTP2870
     F 6H LR   |    /)                                                    OUTP2880
      GO TO 410                                                           OUTP2890
  123 WRITE(NT,2300)                                                      OUTP2900
 2300 FORMAT(1H0,56X,25H|FRONT WHEEL| REAR WHEEL|  /                      OUTP2910
     A62H  TIME   |          TIRE TRACTIVE FORCE (LBS)                |   T OUTP2920
     B20HORQUE  |   TORQUE   |  /                                         OUTP2930
     C62H   SEC   |       RF    |      LF     |       RR    |      LR   |   L OUTP2940
     D20HB-FT   |   LB-FT    |  /)                                        OUTP2950
      GO TO 410                                                           OUTP2960
  124 WRITE(NT,2400)                                                      OUTP2970
 2400 FORMAT(                                                             OUTP2980
     A62H0 TIME   |   Z'-VERTICAL TIRE FORCE (LBS)         |   X'-HORIZO  OUTP2990
     B62HNTAL TIRE FORCE (LBS)      |   Y'-HORIZONTAL TIRE FORCE (LBS)    OUTP3000
     C 6H      |    /                                                     OUTP3010
     D62H   SEC   |    RF    |    LF    |    RR    |    LR    |    RF    |  OUTP3020
     E62H  LF    |    RR    |    LR    |    RF    |    LF    |    RR    |  OUTP3030
     F 6HLR    |    /)                                                    OUTP3040
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      GO TO 410                                                          OUTP3050
  125 WRITE(NT,2500)                                                     OUTP3060
 2500 FORMAT(                                                            OUTP3070
     A62H0 TIME    |       TERRAIN ELEVATION (IN)          |   TERRAIN S OUTP3080
     B62HLOPE-CAMBER (PHIG) (DEG)    |   TERRAIN SLOPE-PITCH (THETAG) (D OUTP3090
     C 6HEG)  |    /                                                     OUTP3100
     D62H   SEC    |    RF    |    LF    |    RR    |    LR    |    RF    | OUTP3110
     E62H  LF    |    RR    |    LR    |    RF    |    LF    |    RR    | OUTP3120
     F 6HLR    |    /)                                                   OUTP3130
      GO TO 410                                                          OUTP3140
  126 WRITE(NT,2600)                                                     OUTP3150
 2600 FORMAT(                                                            OUTP3160
     A62H0 TIME    | SPRUNG MASS ACCELERATION LOCATION 1(G-UNITS)  | SPR OUTP3170
     B44HUNG MASS ACCELERATION LOCATION 2 (G-UNITS) |        /           OUTP3180
     C62H   SEC    |   LONG.    |    LAT.    |   VERT.    |   RESULT. |  L OUTP3190
     D44HONG.    |    LAT.    |   VERT.    |   RESULT. |       /)        OUTP3200
      GO TO 410                                                          OUTP3210
  127 WRITE(NT,2700)                                                     OUTP3220
 2700 FORMAT(                                                            OUTP3230
     A62H0         | INTERFACE |   VEHICLE |   NORMAL   |  FRICTION |  BA OUTP3240
     B44HRRIER  |    POSITION OF APPLIED LOAD          | /               OUTP3250
     C62H  TIME    |   AREA     |DEFORMATION|    FORCE   |    FORCE  |DEFL OUTP3260
     D44HECTION |      XR    |       YR    |      ZR    | /              OUTP3270
     E62H   SEC    |   IN**2    |   INCHES   |     LBS    |     LBS   |   I OUTP3280
     F44HNCHES  |   INCHES   |   INCHES   |   INCHES   | )               OUTP3290
      GO TO 410                                                          OUTP3300
  128 WRITE(NT,2800)                                                     OUTP3310
 2800 FORMAT(1H0,8X,13H|VELOCITY OF|,59X,13H|SPRUNG MASS|  /             OUTP3320
     A62H          |  BARRIER   |    VELOCITY OF CONTACT POINT       |   OUTP3330
     B44H BARRIER ENERGY     | DISSIPATED| FRICTION   | /                OUTP3340
     C62H  TIME    | DEFLECTION|     UR'    |     VR'    |     WR'   | CON OUTP3350
     D44HSERVED | DISSIPATED|   ENERGY   |    WORK    | /               OUTP3360
     E62H   SEC    |   IN/SEC  |   IN/SEC  |   IN/SEC  |   IN/SEC  |     OUTP3370
     F44HFT-LB  |    FT-LB   |    FT-LB   |    FT-LB   | )               OUTP3380
      GO TO 410                                                          OUTP3390
  129 WRITE(NT,2900)                                                     OUTP3400
 2900 FORMAT(                                                            OUTP3410
     A62H0 TIME    |  HARD POINT DEFLECTION - INCHES      |    HARD POINT OUTP3420
     B20HFORCE - LBS        |     /                                      OUTP3430
     C62H   SEC    |    NO. 1   |    NO. 2   |    NO. 3   |    NO. 1   | OUTP3440
     D20HNO. 2  |    NO. 3   |     )                                     OUTP3450
  410 CONTINUE                                                           OUTP3460
  500 NT = 10                                                            OUTP3470
      DO 600 J=1,19                                                      OUTP3480
      IF(NPAGE(J).EQ.0) GO TO 600                                        OUTP3490
      GO TO(11,12,13,14,15,16,17,18,19,20,21,22,23,24,25,26,27,28,29),J  OUTP3500
   11 NT = NT+1                                                          OUTP3510
      ACLON = (DU-VR+WQ)/G                                               OUTP3520
      ACLAT = (DV+UR-WP)/G                                               OUTP3530
      ACVER = (DW+VP-UQ)/G                                               OUTP3540
      ULON = U/12.                                                       OUTP3550
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      VLAT = V/12.
      WVER = W/12.
      ACRES = SQRT(ACLON**2+ACLAT**2+ACVER**2)
      OXCP = XCP/12.
      OYCP = YCP/12.
      OZCP = ZCP/12.
      WRITE(NT,5000) T,OXCP,OYCP,OZCP,ULON,VLAT,WVER,ACLON,ACLAT,ACVER,
     *               ACRES
 5000 FORMAT(' ',F7.4,10(2X,F10.2))
      GO TO 600
   12 NT = NT+1
      ONU = 0.0
      IF(DYCP.EQ.0.0.AND.DXCP.EQ.0.0) GO TO 212
      ONU = ATAN2(DYCP,DXCP)/RAD
  212 ROLL = P/RAD
      PITCH = Q/RAD
      YAW = R/RAD
      PHIO = PHIT/RAD
      THTAO = THETT/RAD
      PSIO = PSIT/RAD
      OBETA = ONU-PSIO
      PSIFO = PSI1/RAD
      IF(ISUS.EQ.1) GO TO 213
      OPSIR = PSI3/RAD
      WRITE(NT,5000) T,ROLL,PITCH,YAW,PHIO,THTAO,PSIO,OBETA,ONU,PSIFO,
     *               OPSIR
      GO TO 600
  213 OPSI3 = PSI3/RAD
      OPSI4 = PSI4/RAD
      WRITE(NT,5004) T,ROLL,PITCH,YAW,PHIO,THTAO,PSIO,OBETA,ONU,PSIFO,
     *               OPSI3,OPSI4
      GO TO 600
   13 NT = NT+1
      GO TO(131,132,133),IS1
  131 OETA3 = DEL3+TRO2*PHIR
      OETA4 = DEL3-TRO2*PHIR
      OETA3D = DEL3D+TRO2*PHIRD
      OETA4D = DEL3D-TRO2*PHIRD
      WRITE(NT,5000) T,DEL1,DEL2,OETA3,OETA4,DEL1D,DEL2D,OETA3D,OETA4D
      GO TO 600
  132 WRITE(NT,5000) T,DEL1,DEL2,DEL3,DEL4,DEL1D,DEL2D,DEL3D,DEL4D
      GO TO 600
 5004 FORMAT(1H ,F7.4,8(2X,F10.2),3(2X,F7.2) )
  133 OETA1 = DEL1+TFO2*PHIF
      OETA2 = DEL1-TFO2*PHIF
      OETA3 = DEL3+TRO2*PHIR
      OETA4 = DEL3-TRO2*PHIR
      OETA1D = DEL1D+TFO2*PHIFD
      OETA2D = DEL1D-TFO2*PHIFD
      OETA3D = DEL3D+TRO2*PHIRD
      OETA4D = DEL3D-TRO2*PHIRD
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      WRITE(NT,5000) T,OETA1,OETA2,OETA3,OETA4,OETA1D,OETA2D,OETA3D,
     *               OETA4D
      GO TO 600
   14 NT = NT+1
      ODP = DP/RAD
      ODQ = DQ/RAD
      ODR = DR/RAD
      IF(ISUS.EQ.1) GO TO 141
      DPHDTO = PHIRD/RAD
      OPHDD = DPHIRD/RAD
      IF(ISUS.EQ.2) GO TO 142
      PHIRO = PHIR/RAD
      WRITE(NT,5001) T,ODP,ODQ,ODR,DDEL1D,DDEL2D,DEL3,DEL3D,DDEL3D,
     *               PHIRO,DPHDTO,OPHDD
 5001 FORMAT(' ',F7.4,3(2X,F10.2),2(2X,F9.1),2X,F7.2,2X,F9.1,2X,
     *       F9.1,2X,F7.2,2X,F9.1,2X,F9.1 )
      GO TO 600
  141 WRITE(NT,5005) T,ODP,ODQ,ODR,DDEL1D,DDEL2D,DDEL3D,DDEL4D
 5005 FORMAT(1H ,F7.3,3(2X,F8.2),10(2X,F7.1) )
      GO TO 600
  142 DPFDTO = PHIFD/RAD
      OPFDD = DPHIFD/RAD
      WRITE(NT,5005) T,ODP,ODQ,ODR,DEL1,DEL1D,DDEL1D,DEL3,DEL3D,DDEL3D,
     *               DPFDTO,OPFDD,DPHDTO,OPHDD
      GO TO 600
   15 NT = NT+1
      ODPSFI = DPSIFI/RAD
      ODDPSF = DDPSFI/RAD
      WRITE(NT,5000) T,T1PSI,T2PSI,ODPSFI,ODDPSF
      GO TO 600
   16 NT = NT+1
      PHRF = PHICI(1)/RAD
      PHLF = PHICI(2)/RAD
      PHRR = PHICI(3)/RAD
      PHLR = PHICI(4)/RAD
      PSRF = PSIIP(1)/RAD
      PSLF = PSIIP(2)/RAD
      PSRR = PSIIP(3)/RAD
      PSLR = PSIIP(4)/RAD
      IF(ISUS.EQ.2) GO TO 162
      PHI1O = PHI1/RAD
      PHI2O = PHI2/RAD
      IF(ISUS.EQ.1) GO TO 161
      WRITE(NT,5000) T,PSRF,PSLF,PSRR,PSLR,PHRF,PHLF,PHRR,PHLR,PHI1O,
     *               PHI2O
      GO TO 600
  161 PHI3O = PHI3/RAD
      PHI4O = PHI4/RAD
      WRITE(NT,5006) T,PSRF,PSLF,PSRR,PSLR,PHRF,PHLF,PHRR,PHLR,PHI1O,
     *               PHI2O,PHI3O,PHI4O
      GO TO 600
```

```
 162 PHIFO = PHIF/RAD
     PHIRO = PHIR/RAD
     WRITE(NT,5000) T,PSRF,PSLF,PSRR,PSLR,PHRF,PHLF,PHRR,PHLR,PHIFO,
    *               PHIRO
5006 FORMAT(1H ,F7.4,8(2X,F10.2),4(1X,F6.2) )
     GO TO 600
  17 NT = NT+1
     VLNRF = UG(1)/12.
     VLNLF = UG(2)/12.
     VLNRR = UG(3)/12.
     VLNLR = UG(4)/12.
     VLTRF = VG(1)/12.
     VLTLF = VG(2)/12.
     VLTRR = VG(3)/12.
     VLTLR = VG(4)/12.
     WRITE(NT,5000) T,VLNRF,VLNLF,VLNRR,VLNLR,VLTRF,VLTLF,VLTRR,VLTLR
     GO TO 600
  18 NT = NT+1
     WRITE(NT,5000) T,(ZGPP(I),I=1,4)
     GO TO 600
  19 NT = NT+1
     WRITE(NT,5000) T,(SI(I),I=1,4),(APITCH(I),I=1,4)
     GO TO 600
  20 NT = NT+1
     IF(ISUS.EQ.2) GO TO 201
     OD1 = -CF*DEL1D
     OD2 = -CF*DEL2D
     GO TO 202
 201 OD1 = -CF*(DEL1D+TSFO2*PHIFD)
     OD2 = -CF*(DEL1D-TSFO2*PHIFD)
 202 IF(ISUS.EQ.1) GO TO 203
     OD3 = -CR*(DEL3D+TSO2*PHIRD)
     OD4 = -CR*(DEL3D-TSO2*PHIRD)
     GO TO 204
 203 OD3 = -CR*DEL3D
     OD4 = -CR*DEL4D
 204 CONTINUE
     OSP1 = -F2FI(1)
     OSP2 = -F2FI(2)
     OSP3 = -F2RI(1)
     OSP4 = -F2RI(2)
     WRITE(NT,5000) T,OD1,OD2,OD3,OD4,OSP1,OSP2,OSP3,OSP4
     GO TO 600
  21 NT = NT+1
     WRITE(NT,5000) T,(FR(I),I=1,4),(HI(I),I=1,4)
     GO TO 600
  22 NT = NT+1
     DO 220 I=1,4
     ASTR(I) = BLNK
     IF(ABS(BETBR(I)).GT.3.0) ASTR(I)=STAR
     PSITEM = PSIIP(I)*SIGN(1.0,UG(I))
```

```
      TERM = 0.0
      IF(UG(I).NE.0.0.OR.VG(I).NE.0.0) TERM = ATAN2(VG(I),ABS(UG(I)))
      SLPANG(I) = (TERM-PSITEM)/RAD
  220 CONTINUE
      WRITE(NT,5003) T,(FRCP(I),I=1,4),(FS(I),ASTR(I),I=1,4),
     *                 (SLPANG(I),I=1,4)
 5003 FORMAT(1H ,F7.4,1X,4(1X,F10.2),4(1X,F9.2,A1),4(1X,F7.2)
      GO TO 600
   23 NT = NT+1
      TQFO = TI(1)*HI(1)/12.
      TQRO = TI(3)*HI(3)/12.
      WRITE(NT,5000) T,(FC(I),I=1,4),TQFO,TQRO
      GO TO 600
   24 NT = NT+1
      FR10 = AMTX(3,1)*FXU(1)+AMTX(3,2)*FYU(1)+AMTX(3,3)*FZU(1)
      FR20 = AMTX(3,1)*FXU(2)+AMTX(3,2)*FYU(2)+AMTX(3,3)*FZU(2)
      FR30 = AMTX(3,1)*FXU(3)+AMTX(3,2)*FYU(3)+AMTX(3,3)*FZU(3)
      FR40 = AMTX(3,1)*FXU(4)+AMTX(3,2)*FYU(4)+AMTX(3,3)*FZU(4)
      FXPU1 = AMTX(1,1)*FXU(1)+AMTX(1,2)*FYU(1)+AMTX(1,3)*FZU(1)
      FXPU2 = AMTX(1,1)*FXU(2)+AMTX(1,2)*FYU(2)+AMTX(1,3)*FZU(2)
      FXPU3 = AMTX(1,1)*FXU(3)+AMTX(1,2)*FYU(3)+AMTX(1,3)*FZU(3)
      FXPU4 = AMTX(1,1)*FXU(4)+AMTX(1,2)*FYU(4)+AMTX(1,3)*FZU(4)
      FYPU1 = AMTX(2,1)*FXU(1)+AMTX(2,2)*FYU(1)+AMTX(2,3)*FZU(1)
      FYPU2 = AMTX(2,1)*FXU(2)+AMTX(2,2)*FYU(2)+AMTX(2,3)*FZU(2)
      FYPU3 = AMTX(2,1)*FXU(3)+AMTX(2,2)*FYU(3)+AMTX(2,3)*FZU(3)
      FYPU4 = AMTX(2,1)*FXU(4)+AMTX(2,2)*FYU(4)+AMTX(2,3)*FZU(4)
      WRITE(NT,5002) T,FR10,FR2C,FR30,FR40,FXPU1,FXPU2,FXPU3,FXPU4,
     *                 FYPU1,FYPU2,FYPU3,FYPU4
 5002 FORMAT(' ',F7.4,12(2X,F8.1) )
      GO TO 600
   25 NT = NT+1
      PHG10 = PHGI(1)/RAD
      PHG20 = PHGI(2)/RAD
      PHG30 = PHGI(3)/RAD
      PHG40 = PHGI(4)/RAD
      THG10 = THGI(1)/RAD
      THG20 = THGI(2)/RAD
      THG30 = THGI(3)/RAD
      THG40 = THGI(4)/RAD
      WRITE(NT,5002) T,(ZPGI(I),I=1,4),PHG10,PHG20,PHG30,PHG40,THG10,
     *                 THG20,THG30,THG40
      GO TO 600
   26 NT = NT+1
      AX1 = (DU-VR+WQ-X1*(Q2+R2)+Y1*(PQ-DR)+Z1*(PR+DQ))/G
      AX2 = (DU-VR+WQ-X2*(Q2+R2)+Y2*(PQ-DR)+Z2*(PR+DQ))/G
      AY1 = (DV+UR-WP+X1*(PQ+DR)-Y1*(P2+R2)+Z1*(QR-DP))/G
      AY2 = (DV+UR-WP+X2*(PQ+DR)-Y2*(P2+R2)+Z2*(QR-DP))/G
      AZ1 = (DW+VP-UQ+X1*(PR-DQ)+Y1*(QR+DP)-Z1*(P2+Q2))/G
      AZ2 = (DW+VP-UQ+X2*(PR-DQ)+Y2*(QR+DP)-Z2*(P2+Q2))/G
      A1R = SQRT(AX1**2+AY1**2+AZ1**2)
      A2R = SQRT(AX2**2+AY2**2+AZ2**2)
```

```
      WRITE(NT,5000) T,AX1,AY1,AZ1,A1R,AX2,AY2,AZ2,A2R
      GO TO600
   27 NT = NT+1
      WRITE(NT,5000) T,AINTI,VDEF,FN,FRICT,DELBB,SXR,SYR,SZR
      GO TO 600
   28 NT = NT+1
      SWORKO = SWORK/12.
      EEEO = EEE/12.
      DISSO = DISS/12.
      SPENGO = SPENGY/12.
      WRITE(NT,5000) T,VMAX(1),URP,VRP,WRP,EEEO,DISSO,SPENGO,SWORKO
      GO TO 600
   29 NT = NT+1
      DO 291 I=1,3
      HDEF(I) = 0.0
      IF(FNSTI(I).NE.0.0) HDEF(I) = YSTIPO(I)-YBP
  291 CONTINUE
      WRITE(NT,5000) T,(HDEF(I),I=1,3),(FNSTI(I),I=1,3)
  600 CONTINUE
      RETURN
      ENTRY THPLOT(IPLT)
      GO TO(901,902,903),IPLT
  901 WRITE(3) (HED(I),I=1,18),DADE(1),DADE(2),(VHED(I),I=1,10),
     A      (THED(I),I=1,10),(CHED(I),I=1,10),(GHED(I),I=1,10),
     B      (SHED(I),I=1,10)
      RETURN
  902 WRITE(3) T,ULON,VLAT,ACLON,ACLAT,ACVER,ACRES,ROLL,PITCH,
     1       YAW,PHIO,THTAO,PSIO,AX1,AY1,AZ1,A1R,AX2,AY2,AZ2,A2R
      RETURN
  903 WRITE(3) (TTTTTT,I=1,21)
      RETURN
      END
```

```
      SUBROUTINE PINT1(IN,MODE,N,/X/,/HH/,YY,YYP,A)
C***********************************************************************
C*                                                                     *
C*    SUBROUTINE PINT1                                                 *
C*                                                                     *
C*    PURPOSE                                                          *
C*      TO SOLVE A SYSTEM OF N REAL ORDINARY DIFFERENTIAL EQUATIONS OF *
C*      THE FIRST ORDER                                                *
C*                                                                     *
C*    USAGE                                                            *
C*      CALL PINT1(IN,MODE,N,X,HH,YY,YYP,A)                            *
C*                                                                     *
C*    DESCRIPTION OF PARAMETERS                                        *
C*      N       NUMBER OF EQUATIONS                                    *
C*      IN      INDICATOR FOR INITIALIZATION OF INTEGRATION STEP , IF  *
C*              IN = 1 THE ROUTINE INITIALIZES                         *
C*              IN = 2 THE ROUTINE INTEGRATES ONE STEP                 *
C*      MODE    THE OPTION WORD(=0,1,OR 2) FOR USING ONE OF THE THREE MOD*
C*              ES OF INTEGRATION.   IF MODE EQUALS                     *
C*                 0 - THE ADAMS-MOULTON VARIABLE STEP-SIZE IS USED,   *
C*                 1 - THE RUNGE-KUTTA FIXED STEP-SIZE IS USED,        *
C*                 2 - THE ADAMS FIXED STEP-SIZE IS USED               *
C*      A       IS AN ARRAY OF DIMENSION SIX CONTAINING THE PARAMETERS *
C*                 FOR THE VARIABLE MODE                               *
C*      X       THE SOURCE VARIABLE                                    *
C*      HH      THE INCREMENT IN SOURCE VARIABLE OR THE STEP SIZE      *
C*      YY      THE TARGET VARIABLES UPDATED BY THIS ROUTINE           *
C*      YYP     THE ARRAY OF FIRST DERIVATIVES OF THE TARGET VARIABLES *
C*               COMPUTED  IN  THE SUBROUTINE DAUX                     *
 1000 CONTINUE
C*   METHOD                                                            *
C*      THE ROUTINE USES THE E.K.BLUM MODIFICATION OF THE RUNGE-KUTTA  *
C*      FOURTH-ORDER METHOD,THE FOURTH ORDER ( FIXED AND VARIABLE )    *
C*      ADAMS-MOULTON PREDICTOR -CORRECTOR METHOD.                      *
C*                                                                     *
C*    REMARKS                                                          *
C*    BEFORE EXECUTING THE FIRST PINT1 CALL, THE USER MUST INITIALIZE  *
C*    X,HH, AND EACH OF THE TARGET VARIABLE.                           *
C*                                                                     *
C*      THE SECOND ENTRY POINT ( IN=2 ) MAY BE USED ANY NUMBER OF TIMES*
C*    AFTER THE FIRST PINT1 CALL (IN=1) TO INTEGRATE ONE STEP-SIZE.    *
C*                                                                     *
C*    SUBROUTINES REQUIRED                                             *
C*       ( ERRMSG ) NOT USED, SEE CARD SERIAL NUMBER05302840           *
C*      THE USER MUST PROVIDE A SUBROUTINE NAMED 'DAUX' WHICH EVALUATES*
C*      THE N DERIVATIVES OF THE SYSTEM OF N FIRST  ORDER DIFFERENIAL  *
C*      EQUATION                                                       *
C*                                                                     *
C*    AUTHOR                                                           *
C*       SQUARE PARTEE                                                 *
C*       AUGUST 1966                                                   *
C*       CORNELL AERONAUTICAL LAB.                                     *
```

```
C*
C*****************************************************************************
      DIMENSION YY(1),YYP(1),A(1)
      DIMENSION Y(30),YNO(30),YN1(30),YN2(30),YN3(30),YPNO(30),YN(30),
     *          YPN(30),YPN1(30),YPN2(30),YPN3(30),P(30),Q(30)
      DOUBLE PRECISION H,DY,Y,YNO,YN,YN1,YN2,YN3,YPNO,YPN,YPN1,YPN2,
     *                 YPN3,DABS,P,Q
      EQUIVALENCE (YPNO(1),P(1))
      EQUIVALENCE (YNO(1),Q(1))
C
C     MODE=0     VARIABLE ADAMS MOULTON METHOD
C     MODE= 1     FIXED RUNGE-KUTTA
C     MODE= 2     FIXED ADAMS MOULTON METHOD
C
    1 INN = IN
      GO TO (2,50),INN
    2 NMODE = MODE + 1
      NDO = 1
      NGO = 1
      NSS = 1
    3 GO TO (8,50,5),NMODE
    5 NGO = 2
      GO TO 50
C
C     SET UP VARIABLE MODE PARAMETERS
C
    8 NGO = 3
      EMAX = ABS(A(1))
      IF (EMAX.EQ.0.0) EMAX = .1E-03
      EMIN = EMAX * .01
      IF (A(2).NE.0.0) EMIN = EMAX/ABS(A(2))
      AA = ABS(A(3))
      IF (AA.EQ.0.0) AA = 1.0
      HMAX = ABS(A(4))
      IF(HMAX.EQ.0.0) HMAX = 10.E+03
      HMIN = ABS(A(5))
      IF (HMIN.EQ.0.0)  HMIN = .1E-06
      BETA = ABS(A(6))
      IF (BETA.GE.1.0 .OR. BETA.LE.0.0) BETA = .5
      NMSG = 0
C
   50 GO  TO ( 100, 111, 200, 300    ) , NDO
C
C         FIXED RUNGE - KUTTA      INITIALIZATION
  100 DO 102  I=1,N
      Q(I) = 0.0
      Y(I) = YY(I)
  102 CONTINUE
      NSTEP = 0
  103 CALL  DAUX
  106 XOO = X
      H = HH
      IF (NGO.EQ.1) GO TO 110
```

```
  108 XN3 = X
      DO 109  I=1,N
      YPN3(I) = YYP(I)
      YN3(I) = YY(I)
  109 CONTINUE
  110 NDO = 2
      IF (   NSS .EQ. 1 )   RETURN
C
C               ONE  POINT  INTEGRATE
C
  111 XOO = X
      H = HH
      DO 112  I=1,N
      DY = YYP(I)
      P(I) = H*DY
      Y(I) = Y(I)+.5DO*P(I)
      Q(I) = P(I)
        YY(I)  = Y(I)
  112 CONTINUE
      X = XOO +  .5 * HH
      CALL  DAUX
  113 DO 115  I=1,N
      DY = YYP(I)
      P(I) = H*DY
      Y(I) = Y(I)+.5DO*P(I)-.5DO*Q(I)
      Q(I) = Q(I)/6.DO
        YY(I)  = Y(I)
  115 CONTINUE
  116 CALL  DAUX
  117 DO 120  I=1,N
      DY = YYP(I)
      P(I) = H*DY-.5DO*P(I)
      Y(I) = Y(I)+P(I)
      Q(I) = Q(I)-P(I)
        YY(I)  = Y(I)
  120 CONTINUE
      X = XOO  +  HH
      CALL  DAUX
  121 DO 125  I=1,N
      DY = YYP(I)
      P(I) = H*DY+2.0*P(I)
      Y(I) = Y(I) + Q(I)+P(I)/6.0DO
        YY(I)  = Y(I)
  125 CONTINUE
      CALL  DAUX
C
C            END OF FIXED STEP RUNGE - KUTTA
C
C
C
  130 IF  ( NGO   .EQ. 1   )     RETURN
  135 NSTEP = NSTEP + 1
      GO TO (136,140,145), NSTEP
```

```
C
C     SET UP THREE POINTS FOR ADAMS-MOULTON'S
C
  136 XN2 = X
      DO 138  I=1,N
      YPN2(I)  =  YYP(I)
  138 YN2(I) = Y(I)
      RETURN
  140 XN1 = X
      DO 142  I=1,N
      YPN1(I)  =  YYP(I)
      YN1(I) = Y(I)
  142 CONTINUE
      RETURN
  145 XN = X
      DO 146  I=1,N
      YN(I) = Y(I)
      YPN (I)  =  YYP(I)
  146 CONTINUE
      NSTEP = 0
      NFIRST = 1
      NCRE = 0
      NDO = NGO + 1
      RETURN
C
C
C      FIXED ADAMS MOULTON PREDICTOR METHOD
C
  200 XOO = X
      H = HH
      X = XOO  +  HH
      DO 220  I=1,N
      Y(I) = YN(I)+H*(55.D0*YPN(I)-59.D0*YPN1(I)+37.D0*YPN2(I)-9.0D0*
     4   YPN3(I)) / 24.D0
        YY(I)  = Y(I)
  220 CONTINUE
      CALL  DAUX
      DO 225  I=1,N
      DY = YYP(I)
      Y(I) = YN(I)+H*(9.D0*DY    +19.D0*YPN(I)-5.D0*YPN1(I)+YPN2(I))
     5    / 24.D0
        YY(I)  = Y(I)
  225 CONTINUE
      CALL  DAUX
      DO 250  I=1,N
C     SAVE VALUES
      YPN3(I) = YPN2(I)
      YPN2(I) = YPN1(I)
      YPN1(I) = YPN(I)
      YPN(I)   =   YYP(I)
      YN3(I) = YN2(I)
      YN2(I) = YN1(I)
      YN1(I) = YN(I)
```

```
      YN(I) = Y(I)
  250 CONTINUE
  251 XN3 = XN2
      XN2 = XN1
      XN1 = XN
      XN = X
      RETURN
C
C     VARIABLE ADAMS MOULTON METHOD
C
C
  300 XOO = X
      H = HH
      X = XOO  +  HH
      DO 364  I=1,N
       Y(I)= YN(I)+H*(55.D0*YPN(I)-59.D0*YPN1(I)+37.D0*YPN2(I)-9.D0*
     6       YPN3(I)) / 24.D0
        YY(I)  = Y(I)
      P(I) = Y(I)
  364 CONTINUE
      CALL  DAUX
      DO 365  I=1,N
      DY = YYP(I)
      Y(I) = YN(I)+H*(9.D0*DY   +19.D0*YPN(I)-5.D0*YPN1(I)+YPN2(I))
     7          / 24.D0
        YY(I)  = Y(I)
  365 CONTINUE
      CALL  DAUX
C
C     END VARIABLE ADAM MOULTON
C
      ERROR = 0.0
      DO 370  I=1,N
      PRED = SNGL(P(I))
C
C     SAVE VALUES
  366 YPNO(I) = YPN3(I)
      YPN3(I) = YPN2(I)
      YPN2(I) = YPN1(I)
      YPN1(I) = YPN(I)
      YPN(I)  = YYP(I)
      YNO(I) = YN3(I)
      YN3(I) = YN2(I)
      YN2(I) = YN1(I)
      YN1(I) = YN(I)
      YN(I) = Y(I)
      DD = AMAX1(ABS(SNGL(Y(I))),AA)
      DERR = ABS(PRED-SNGL(Y(I)))/(14.0*DD)
      ERROR = AMAX1(ERROR,DERR)
  370 CONTINUE
  375 XNO = XN3
      XN3 = XN2
      XN2 = XN1
```

```
      XN1 = XN
      XN = X
C     ERROR TESTS     ADAMS MOULTON
C
  305 IF (ERROR.GT.EMAX) GO TO 315
      NFIRST = 2
      IF (ERROR.LT.EMIN) GO TO 330
  306 NFIRST = 2
      NCRE = 0
      RETURN
C
C     REDUCE STEP SIZE
C
  315 NSS=2
      NCRE = 0
  316 HH = HH*BETA
      IF( ABS(HH) .GT.  HMIN  )  GO  TO  319
      HH = SIGN( HMIN, HH  )
      IF (NMSG.NE.0) GO TO 306
C
C     CALL ERRMSG(10  ,39H  MINIMUM STEP SIZE  IN  PINT1
      WRITE(6,317)
  317 FORMAT(28H0 MINIMUM STEP SIZE IN PINT1)
C
      NMSG = 1
      A(1) =-A(1)
C
  319 GO TO (    320,325), NFIRST
C     ERROR FIRST VARIABLE POINT
  320 X = XN0
      DO 321  I=1,N
      YY(I) = YN0(I)
  321 CONTINUE
      GO TO   100
C     ERROR DURING VARIABLE MODE
  325 X = XN1
      DO 327  I=1,N
      YY(I) = YN1(I)
  327 CONTINUE
      GO TO   100
C
C     INCREASE STEP SIZE HERE
C
  330 NSS = 1
      NCRE = NCRE + 1
      IF (NCRE.LE.2) RETURN
C     NOW INCREASE
  335 NCRE = 0
      HH = SIGN(AMIN1(ABS(HH/BETA),HMAX),HH)
      GO TO 106
      END
```

```
      SUBROUTINE PLOTTP(IPLT)
      COMMON/INPT/PHIO,THETAO,PSIO,PO,QO,RO,XCOP,YCOP,ZCOP,UO,VO,WO,
     1            A,B,DEL10,DEL20,DEL30,PHIRO,DEL10D,DEL20D,DEL30D,
     2            PHIROD,TF,TR,ZF,ZR,RHO,AKRS,XMUR,
     3            XMS,XMUF,XIX,XIY,XIZ,XIXZ,CF,AKF,XLAMF,OMEGF,CFP,EPSF,
     4            RF,CR,AKR,XLAMR,OMEGR,CRP,EPSR,RR,TS,THMAX,DTCOMP,TO,
     5            T1,DTCMP1,DTPRNT,MODE,EBAR,EM,AAA,HMAX,HMIN,BET,G,
     6            HED(36),DADE(3),XIR,X1,Y1,Z1,X2,Y2,Z2,PHIC(50),DELB,
     7            DELE,DDEL,NDEL,PSIF(50),TQF(50),TQR(50),TB,TE,TINCR,
     8            NZTAB,NZ5,XBDRY(4,5),PSBDRY(4,5),YBDRY(2,5),NBX(5),
     9            NBY(5),NTBL1,NTBL2,NTBL3,ZGP(21,21,5)
      COMMON/INPT/XB(5),XE(5),XINCR(5),NX(5),YB(5),YE(5),YINCR(5),NY(5),
     1         XXZGP5(21),YYZGP5(21),AMUG(5),PSBDRO(4,5),UVWMIN,PQRMIN
      COMMON /INTG/NEQ,T,DT,VAR(50),DER(50)
      EQUIVALENCE (U,VAR(1)),(V,VAR(2)),(W,VAR(3)),(P,VAR(4)),(Q,VAR(5))
     1           ,(R,VAR(6)),(DEL1,VAR(7)),(DEL1D,VAR(8)),(DEL2,VAR(9)),
     2            (DEL2D,VAR(10)),(DEL3,VAR(11)),(DEL3D,VAR(12)),
     3            (PHIR,VAR(13)),(PHIRD,VAR(14)),(THETTP,VAR(15)),
     4            (PHITP,VAR(16)),(PSITP,VAR(17)),(XCP,VAR(18)),
     5            (YCP,VAR(19)),(ZCP,VAR(20)),(PSIFI,VAR(21)),
     6            (PSIFID,VAR(22))
      EQUIVALENCE (DU,DER(1)),(DV,DER(2)),(DW,DER(3)),(DP,DER(4)),
     1            (DQ,DER(5)),(DR,DER(6)),(DDEL1,DER(7)),(DDEL1D,DER(8))
     2           ,(DDEL2,DER(9)),(DDEL2D,DER(10)),(DDEL3,DER(11)),
     3            (DDEL3D,DER(12)),(DPHIR,DER(13)),(DPHIRD,DER(14)),
     4            (DTHTTP,DER(15)),(DPHITP,DER(16)),(DPSITP,DER(17)),
     5            (DXCP,DER(18)),(DYCP,DER(19)),(DZCP,DER(20)),
     6            (DPSIFI,DER(21)),(DDPSFI,DER(22))
      EQUIVALENCE (VAR(9),PHIF),(VAR(10),PHIFD),(DER(9),DPHIF),
     1            (DER(10),DPHIFD)
      EQUIVALENCE (VAR(13),DEL4),(VAR(14),DEL4D),(DER(13),DDEL4),
     1            (DER(14),DDEL4D)
      COMMON /DIMV/X1P,X2P,X3P,X4P,Y1P,Y2P,Y3P,Y4P,Z1P,Z2P,Z3P,Z4P,PHI1,
     1              PHI2,PHI3,PHI4,PSI1,PSI2,PSI3,PSI4,CAYW(4),CBYW(4),
     2              CGYW(4),ZPG1(4),THGI(4),PHGI(4),CPG(4),SPG(4),CTG(4),
     3              STG(4),CAGZ(4),CBGZ(4),CGGZ(4),D1(4),D2(4),D3(4),
     4              XLM1(4),XLM2(4),XLM3(4),AMTX(3,3),CMTX(3,4),XGPP(4),
     5              YGPP(4),ZGPP(4),DMATX(10,11),DELTA(4),CAR(4),CBR(4),
     6              CGR(4),FR(4),HI(4),FC(4),TI(4),AX(4),BX(4),CX(4),
     7              CTXG(4),UG(4),STXG(4),AY(4),BY(4),CY(4),CPYG(4),
     8              SPYG(4),VG(4),PSIIP(4),PHICI(4),CAC(4),CBC(4),CGC(4),
     9              FCXU(4),FCYU(4),FCZU(4),FS(4),CAXW(4),CBXW(4),CGXW(4)
      COMMON /DIMV/AS(4),BS(4),CS(4),CAS(4),CBS(4),CGS(4),BETP(4),
     1              BETBR(4),FSXU(4),FSYU(4),FSZU(4),FRXU(4),FRYU(4),
     2              FRZU(4),FXU(4),FYU(4),FZU(4),SI(4),F1FI(2),F1RI(2),
     3              F2FI(2),F2RI(2),CAH(4),CBH(4),CGH(4)
      DIMENSION XP(4),YP(4),ZP(4),PHII(4),PSII(4)
      EQUIVALENCE (XP(1),X1P),(YP(1),Y1P),(ZP(1),Z1P),(PHII(1),PHI1),
     1            (PSII(1),PSI1)
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      COMMON /COMP/SUMM,THETN,PHIN,PSIN,PI,RAD,GAM1,GAM2,GAM3,GAM4,GAM5,PLOT0500
     1          GAM6,GAM7,GAM8,GAM9,THETT,PHIT,PSIT,ZRO,TRO2,           PLOT0510
     2          TFO2,TIZ,RHO2,RHOMUR,AMUF,BMUR,ZPR,TM4,RHMR2,AO2APB,    PLOT0520
     3          BO2APB,RFTF,TSO2,RRTS,BROMUR,XMUFO2,AXMFO2,XMTFO4,      PLOT0530
     4          XIZR,RTR,RHMR2I,XIXP,XIZP,XIXZP,XIYZP,D1PD2,D1MD2,      PLOT0540
     5          ZRD3,ZRD3R,ZFD3R,ZFD12,TIZ2,TG61,DD1P2,DD1M2,RPR,PHRPPLOT0550
     6          ,TANTP,SPHTP,CPHTP,SECTP,SFXS,SFYS,SFZS,SNPS,SNTS,      PLOT0560
     7          SNPSS,TPR,CAY,CBY,CGY,CAX,CBX,CGX,SFYU,SFXU,SFYUF,      PLOT0570
     8          SFYUR,SFZU,COSTH,SINTH,COSPS,SINPS,COSPH,SINPH,ANG1,    PLOT0580
     9          ANG2,CPHI,SPHI,CPSI,SPSI,P1,P7,P3,P4,P5,P6,TX,TY,TZ     PLOT0590
      COMMON /COMP/TRH,DISTX,DISTY,DISTD,DISTS,D21,ZETA4,ZETA4D,ZETA3,  PLOT0600
     1          ZETA3D,SFZ1,SNPU,SNTU,HCGH1,HCGH2,HCGH3,HCGH4,TERM1,    PLOT0610
     2          TERM2,SNPSU,SNPR,HCBH1,HCBH2,HCBH3,HCBH4,HCAH1,HCAH2,PLOT0620
     3          HCAH3,HCAH4,UQ,WP,UR,QR,VP,PR,P2,Q2,R2,VR,WQ,PQ,PHIR2PLOT0630
     4          ,PHIRD2,RPHRD,GCTH,GSTH,GCTSP,GCTCP,XXX,YYY,IX,IY,XX1,PLOT0640
     5          XX2,YY1,YY2,THG1,THG2,PHG1,PHG2,ZZ1,ZZ2,LLL             PLOT0650
      DIMENSION HCAH(4),HCBH(4),HCGH(4)                                 PLOT0660
      EQUIVALENCE (HCAH(1),HCAH1).(HCBH(1),HCBH1),(HCGH(1),HCGH1)       PLOT0670
      COMMON /COMPN/ FRSP(4),FRCP(4),ICBHIT,JCBHIT,                     PLOT0680
     1             DPSINT,TANPC1,TANPC2,PHIC1R,PHIC2R,AMUCMP,PHI1D,     PLOT0690
     2             PHI2D,LCB1(4),LCB2(4),IHIT,AJMTX(3,3),BMTX(3,3),     PLOT0700
     3             SFRX(4),SFRY(4),SFRZ(4),T1PSI,T2PSI,XMUGI(4)         PLOT0710
      LOGICAL LCB1,LCB2                                                 PLOT0720
      COMMON /TIRIN/ AKT(4),SIGT(4),XLAMT(4),A0(4),A1(4),A2(4),A3(4),   PLOT0730
     1             A4(4),OMEGT(4),AMU(4),RW(4),FJP(35,4),A234(4),       PLOT0740
     2             A12(4),OMT2A2(4),OMT2M1(4),A23(4),ITIR(4)            PLOT0750
      DIMENSION ICONTW(4)                                               PLOT0760
      DATA TTTTTT/-9999.0/                                              PLOT0770
    1 GO TO (2,3,4),IPLT                                                PLOT0780
    2 WRITE(1)HED,DADE,A,B,TS,ZR,RHO,ZF,RW(1),TF,TR                     PLOT0790
      RETURN                                                            PLOT0800
    3 DO 6 J=1,4                                                        PLOT0810
      IF(FRCP(J).GT.0.01) GO TO 5                                       PLOT0820
      ICONTW(J) = 0                                                     PLOT0830
      GO TO 6                                                           PLOT0840
5     ICONTW(J) = 1                                                     PLOT0850
      IF(ABS(BETBR(J)).GT.3.0) ICONTW(J)= -1                            PLOT0860
6     CONTINUE                                                          PLOT0870
      WRITE(1) T,XCP,YCP,ZCP,PHIT,THETT,PSIT,DEL1,DEL2,DEL3,PHIR,PSI1,  PLOT0880
     1 PHI1,PHI2,(XGPP(J),YGPP(J),ZGPP(J),J=1,4),ICONTW                 PLOT0890
      RETURN                                                            PLOT0900
    4 WRITE(1) (TTTTTT,I=1,30)                                          PLOT0910
      RETURN                                                            PLOT0920
      END                                                               PLOT0930
```

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      SUBROUTINE POLY(CO,C,X,Y,C1)
C               HVOSM-RD2 VERSION
C               REVISED OCTOBER 1975   CALSPAN CORPORATION
C        SINGLE VEHICLE ACCIDENT SIMULATION - SUBROUTINE POLY
C     SUBROUTINE TO FIND ROOT OF FIFTH DEGREE POLYNOMIAL USING NEWTON-
C           RAPHSON METHOD
      DIMENSION C(5)
    1 C2 = CO-C1
      Z = X-Y
      KK = 0
    2 KK = KK+1
      IF(KK.GT.100)GO TO 8
      P = C2
      PP = 0.0
      XX = 1.0
      YY = Z
    3 DO 5 I=1,5
      P = P+C(I)*YY
      PP = PP+C(I)*XX*I
      XX = YY
      YY = YY*Z
    5 CONTINUE
    7 H1 = P/PP
      Z = Z-H1
      IF(ABS(H1/Z).GT.1.0E-6)GO TO 2
    8 Y = X-Z
      RETURN
      END
```

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      SUBROUTINE RESFRC                                                 RESF0010
C             HVOSM-RD2 VERSION                                         RESF0020
C             REVISED OCTOBER 1975   CALSPAN CORPORATION                RESF0030
      COMMON /INTG/NEQ,T,DT,VAR(50),DER(50)                             RESF0040
      EQUIVALENCE (U,VAR(1)),(V,VAR(2)),(W,VAR(3)),(P,VAR(4)),(Q,VAR(5))RESF0050
     1          ,(R,VAR(6)),(DEL1,VAR(7)),(DEL1D,VAR(8)),(DEL2,VAR(9)),RESF0060
     2           (DEL2D,VAR(10)),(DEL3,VAR(11)),(DEL3D,VAR(12)),        RESF0070
     3           (PHIR,VAR(13)),(PHIRD,VAR(14)),(THETTP,VAR(15)),       RESF0080
     4           (PHITP,VAR(16)),(PSITP,VAR(17)),(XCP,VAR(18)),         RESF0090
     5           (YCP,VAR(19)),(ZCP,VAR(20)),(PSIFI,VAR(21)),           RESF0100
     6           (PSIFID,VAR(22))                                       RESF0110
      EQUIVALENCE (DU,DER(1)),(DV,DER(2)),(DW,DER(3)),(DP,DER(4)),      RESF0120
     1           (DQ,DER(5)),(DR,DER(6)),(DDEL1,DER(7)),(DDEL1D,DER(8))RESF0130
     2          ,(DDEL2,DER(9)),(DDEL2D,DER(10)),(DDEL3,DER(11)),       RESF0140
     3           (DDEL3D,DER(12)),(DPHIR,DER(13)),(DPHIRD,DER(14)),     RESF0150
     4           (DTHTTP,DER(15)),(DPHITP,DER(16)),(DPSITP,DER(17)),    RESF0160
     5           (DXCP,DER(18)),(DYCP,DER(19)),(DZCP,DER(20)),          RESF0170
     6           (DPSIFI,DER(21)),(DDPSFI,DER(22))                      RESF0180
      EQUIVALENCE (VAR(9),PHIF),(VAR(10),PHIFD),(DER(9),DPHIF),         RESF0190
     1           (DER(10),DPHIFD)                                       RESF0200
      EQUIVALENCE (VAR(13),DEL4),(VAR(14),DEL4D),(DER(13),DDEL4),       RESF0210
     1           (DER(14),DDEL4D)                                       RESF0220
      COMMON /DIMV/X1P,X2P,X3P,X4P,Y1P,Y2P,Y3P,Y4P,Z1P,Z2P,Z3P,Z4P,PHI1,RESF0230
     1            PHI2,PHI3,PHI4,PSI1,PSI2,PSI3,PSI4,CAYW(4),CBYW(4),   RESF0240
     2            CGYW(4),ZPGI(4),THGI(4),PHGI(4),CPG(4),SPG(4),CTG(4),RESF0250
     3            STG(4),CAGZ(4),CBGZ(4),CGGZ(4),D1(4),D2(4),D3(4),     RESF0260
     4            XLM1(4),XLM2(4),XLM3(4),AMTX(3,3),CMTX(3,4),XGPP(4),  RESF0270
     5            YGPP(4),ZGPP(4),DMATX(10,11),DELTA(4),CAR(4),CBR(4),  RESF0280
     6            CGR(4),FR(4),HI(4),FC(4),TI(4),AX(4),BX(4),CX(4),     RESF0290
     7            CTXG(4),UG(4),STXG(4),AY(4),BY(4),CY(4),CPYG(4),      RESF0300
     8            SPYG(4),VG(4),PSIIP(4),PHICI(4),CAC(4),CBC(4),CGC(4),RESF0310
     9            FCXU(4),FCYU(4),FCZU(4),FS(4),CAXW(4),CBXW(4),CGXW(4)RESF0320
      COMMON /DIMV/AS(4),BS(4),CS(4),CAS(4),CBS(4),CGS(4),BETP(4),      RESF0330
     1            BETBR(4),FSXU(4),FSYU(4),FSZU(4),FRXU(4),FRYU(4),     RESF0340
     2            FRZU(4),FXU(4),FYU(4),FZU(4),SI(4),F1FI(2),F1RI(2),   RESF0350
     3            F2FI(2),F2RI(2),CAH(4),CBH(4),CGH(4)                  RESF0360
      DIMENSION XP(4),YP(4),ZP(4),PHII(4),PSII(4)                       RESF0370
      EQUIVALENCE (XP(1),X1P),(YP(1),Y1P),(ZP(1),Z1P),(PHII(1),PHI1),   RESF0380
     1           (PSII(1),PSI1)                                         RESF0390
      COMMON /COMP/SUMM,THETN,PHIN,PSIN,PI,RAD,GAM1,GAM2,GAM3,GAM4,GAM5,RESF0400
     1           GAM6,GAM7,GAM8,GAM9,THETT,PHIT,PSIT,ZRO,TRO2,          RESF0410
     2            TFO2,TIZ,RHO2,RHOMUR,AMUF,BMUR,ZPR,TM4,RHMR2,AO2APB,  RESF0420
     3            BO2APB,RFTF,TSO2,RRTS,BROMUR,XMUFO2,AXMFO2,XMTFO4,    RESF0430
     4            XIZR,RTR,RHMR2I,XIXP,XIZP,XIXZP,XIYZP,D1PD2,D1MD2,    RESF0440
     5            ZRD3,ZRD3R,ZFD3R,ZFD12,TIZ2,TG61,DD1P2,DD1M2,RPR,PHRPRESF0450
     6           ,TANTP,SPHTP,CPHTP,SECTP,SFXS,SFYS,SFZS,SNPS,SNTS,     RESF0460
     7            SNPSS,TPR,CAY,CBY,CGY,CAX,CBX,CGX,SFYU,SFXU,SFYUF,    RESF0470
     8            SFYUR,SFZU,COSTH,SINTH,COSPS,SINPS,COSPH,SINPH,ANG1,  RESF0480
     9            ANG2,CPHI,SPHI,CPSI,SPSI,P1,P7,P3,P4,P5,P6,TX,TY,TZ   RESF0490
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      COMMON /COMP/TRH,DISTX,DISTY,DISTD,DISTS,D21,ZETA4,ZETA4D,ZETA3,  RESF0500
     1          ZETA3D,SFZ1,SNPU,SNTU,HCGH1,HCGH2,HCGH3,HCGH4,TERM1,    RESF0510
     2          TERM2,SNPSU,SNPR,HCBH1,HCBH2,HCBH3,HCBH4,HCAH1,HCAH2,   RESF0520
     3          HCAH3,HCAH4,UQ,WP,UR,QR,VP,PR,P2,Q2,R2,VR,WQ,PQ,PHIR2RESF0530
     4         ,PHIRD2,RPHRD,GCTH,GSTH,GCTSP,GCTCP,XXX,YYY,IX,IY,XX1,RESF0540
     5          XX2,YY1,YY2,THG1,THG2,PHG1,PHG2,ZZ1,ZZ2,LLL             RESF0550
      DIMENSION HCAH(4),HCBH(4),HCGH(4)                                 RESF0560
      EQUIVALENCE (HCAH(1),HCAH1),(HCBH(1),HCBH1),(HCGH(1),HCGH1)       RESF0570
      COMMON /INPT2/ YBPO,ZBTP,ZBBP,XVF,XVR,YV,ZVT,ZVB,AKV,SIGR(11),    RESF0580
     1          SET,CONS,AMUB,EPSV,EPSB,XM,EPST,DDD,INDB,DELYBP,        RESF0590
     2          DELTB,XINPT(100)                                        RESF0600
      COMMON/BARIER/FN,IBHIT,JBHIT,XCPNP(3),YCPNP(3),ZCPNP(3),XCPN(3),  RESF0610
     1          YCPN(3),ZCPN(3),AA1(17),BB1(17),CC1(17),RR1(17),        RESF0620
     2          AA2(17),BB2(17),CC2(17),RR2(17),CAB,CBB,CGB,CABT,       RESF0630
     3          CBBT,CGBT,RB,XBT,YBT,ZBT,XBB,YBB,ZBB,RR2P(17),          RESF0640
     4          YBPT,XNN(17),YNN(17),ZNN(17),XMTX(3,4),IDPT(17),IPT     RESF0650
     5          ,ININD,UNP(17),VNP(17),WNP(17),VMAX(4),I1,I2,I3,I4,     RESF0660
     6          XCPTP,YCPTP,ZCPTP,XCPBP,YCPBP,ZCPBP,YCPMP,AINTI,        RESF0670
     7          AINTP,SXR,SYR,SZR,SDEN,XRI,YRI,ZRI,FRICT,DELBB,VTAN,RESF0680
     8          FNP,FB,URP,VRP,WRP,EPSL,XLDP,DELX,VL,NCYC,EEE,ENRGY,RESF0690
     9          NSEG,YBPTP,PCAB,PCBB,PCGB,PPRB,CAB1,CBB1,CGB1,          RESF0700
     A          RB1,NUNLD,NLDCTR,VDEF,PVDEF,PSZR,XF,DELBBP,             RESF0710
     B          SWORK,SPENGY,DISS,IPLN,ILOAD                            RESF0720
      DIMENSION INDXPT(4)                                               RESF0730
      EQUIVALENCE (INDXPT(1),I1)                                        RESF0740
      COMMON/BARSTR/ XSTIO(3),YSTIO(3),ZSTIO(3),XSTI(3),YSTI(3),        RESF0750
     1          ZSTI(3),YSTIPO(3),XSTIP(3),YSTIP(3),ZSTIP(3),           RESF0760
     2          FNSTI(3),AKST(3)                                        RESF0770
      COMMON /HARDPT/ FRICF(4),UPT(4),VPT(4),WPT(4)                     RESF0780
      DIMENSION X(4),Y(4),Z(4),F(4)                                     RESF0790
      SFXS = 0.0                                                        RESF0800
      SFYS = 0.0                                                        RESF0810
      SFZS = 0.0                                                        RESF0820
      SNPS = 0.0                                                        RESF0830
      SNTS = 0.0                                                        RESF0840
      SNPSS= 0.0                                                        RESF0850
      X(1) = SXR/SDEN                                                   RESF0860
      Y(1) = SYR/SDEN                                                   RESF0870
      Z(1) = SZR/SDEN                                                   RESF0880
      SXR = X(1)                                                        RESF0890
      SYR = Y(1)                                                        RESF0900
      SZR = Z(1)                                                        RESF0910
      F(1) = FN                                                         RESF0920
      DO 4 J=1,3                                                        RESF0930
      K = J+1                                                           RESF0940
      X(K) = XSTI(J)                                                    RESF0950
      Y(K) = YSTI(J)                                                    RESF0960
      Z(K) = ZSTI(J)                                                    RESF0970
    4 F(K) = FNSTI(J)                                                   RESF0980
      DO 5 J=1,4                                                        RESF0990
      FRICF(J) = 0.0                                                    RESF1000
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      TEMP1 = U-R*Y(J)+Q*Z(J)
      TEMP2 = V+R*X(J)-P*Z(J)
      TEMP3 = W+P*Y(J)-Q*X(J)
      UPT(J) = AMTX(1,1)*TEMP1+AMTX(1,2)*TEMP2+AMTX(1,3)*TEMP3
      VPT(J) = AMTX(2,1)*TEMP1+AMTX(2,2)*TEMP2+AMTX(2,3)*TEMP3
      WPT(J) = AMTX(3,1)*TEMP1+AMTX(3,2)*TEMP2+AMTX(3,3)*TEMP3
      TMPV = SQRT(UPT(J)**2+WPT(J)**2)
      IF(J.EQ.1) VTAN = TMPV
      TEMP1 = 0.0
      TEMP2 = 0.0
      IF(TMPV.LT.EPSV) GO TO 6
      AA = AMUB*F(J)
      FRICF(J) = AA
      AA = AA/TMPV
      TEMP1 = -AA*UPT(J)
      TEMP2 = -AA*WPT(J)
    6 CONTINUE
      FX = AMTX(1,1)*TEMP1-AMTX(2,1)*F(J)+AMTX(3,1)*TEMP2
      FY = AMTX(1,2)*TEMP1-AMTX(2,2)*F(J)+AMTX(3,2)*TEMP2
      FZ = AMTX(1,3)*TEMP1-AMTX(2,3)*F(J)+AMTX(3,3)*TEMP2
      TEMP1 = 0.
      TEMP2 = 0.
      SFXS = SFXS+FX
      SFYS = SFYS+FY
      SFZS = SFZS+FZ
      SNPS = SNPS+FZ*Y(J)-FY*Z(J)
      SNTS = SNTS+FX*Z(J)-FZ*X(J)
    5 SNPSS= SNPSS+FY*X(J)-FX*Y(J)
      FRICT = FRICF(1)
      URP = UPT(1)
      VRP = VPT(1)
      WRP = WPT(1)
      RETURN
      END
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      SUBROUTINE RUFFRC(I,ZGM)
C           HVOSM-RD2 VERSION
C           HVOSM-VD2 VERSION
C              REVISED OCTOBER 1975  CALSPAN CORPORATION
      COMMON/INPT1/YC1P,YC2P,ZC2P,DELTC,PHIC1,PHIC2,AMUC,XIPS,
     1             CPSP,OMGPS,AKPS,EPSPS,XPS,RWHJB,RWHJE,DRWHJ,INDCRB,
     2             PSIFIO,PSIFDO
      DIMENSION YCIP(2)
      EQUIVALENCE (YCIP(1),YC1P)
      COMMON /DIMV/X1P,X2P,X3P,X4P,Y1P,Y2P,Y3P,Y4P,Z1P,Z2P,Z3P,Z4P,PHI1,
     1             PHI2,PHI3,PHI4,PSI1,PSI2,PSI3,PSI4,CAYW(4),CBYW(4),
     2             CGYW(4),ZPG1(4),THG1(4),PHGI(4),CPG(4),SPG(4),CTG(4),
     3             STG(4),CAGZ(4),CBGZ(4),CGGZ(4),D1(4),D2(4),D3(4),
     4             XLM1(4),XLM2(4),XLM3(4),AMTX(3,3),CMTX(3,4),XGPP(4),
     5             YGPP(4),ZGPP(4),DMATX(10,11),DELTA(4),CAR(4),CBR(4),
     6             CGR(4),FR(4),HI(4),FC(4),TI(4),AX(4),BX(4),CX(4),
     7             CTXG(4),UG(4),STXG(4),AY(4),BY(4),CY(4),CPYG(4),
     8             SPYG(4),VG(4),PSIIP(4),PHICI(4),CAC(4),CBC(4),CGC(4),
     9             FCXU(4),FCYU(4),FCZU(4),FS(4),CAXW(4),CBXW(4),CGXW(4)
      COMMON /DIMV/AS(4),BS(4),CS(4),CAS(4),CBS(4),CGS(4),BETP(4),
     1             BETBR(4),FSXU(4),FSYU(4),FSZU(4),FRXU(4),FRYU(4),
     2             FRZU(4),FXU(4),FYU(4),FZU(4),SI(4),F1FI(2),F1RI(2),
     3             F2FI(2),F2RI(2),CAH(4),CBH(4),CGH(4)
      DIMENSION XP(4),YP(4),ZP(4),PHII(4),PSII(4)
      EQUIVALENCE (XP(1),X1P),(YP(1),Y1P),(ZP(1),Z1P),(PHII(1),PHI1),
     1             (PSII(1),PSI1)
      COMMON /COMP/SUMM,THETN,PHIN,PSIN,PI,RAD,GAM1,GAM2,GAM3,GAM4,GAM5,
     1            GAM6,GAM7,GAM8,GAM9,THETT,PHIT,PSIT,ZRO,TRO2,
     2             TFO2,TIZ,RHO2,RHOMUR,AMUF,BMUR,ZPR,TM4,RHMR2,AO2APB,
     3             BO2APB,RFTF,TSO2,RRTS,BROMUR,XMUFO2,AXMFO2,XMTFO4,
     4             XIZR,RTR,RHMR2I,XIXP,XIZP,XIXZP,XIYZP,D1PD2,D1MD2,
     5             ZRD3,ZRD3R,ZFD3R,ZFD12,TIZ2,TG61,DD1P2,DD1M2,RPR,PHRP
     6            ,TANTP,SPHTP,CPHTP,SECTP,SFXS,SFYS,SFZS,SNPS,SNTS,
     7             SNPSS,TPR,CAY,CBY,CGY,CAX,CBX,CGX,SFYU,SFXU,SFYUF,
     8             SFYUR,SFZU,COSTH,SINTH,COSPS,SINPS,COSPH,SINPH,ANG1,
     9             ANG2,CPHI,SPHI,CPSI,SPSI,P1,P7,P3,P4,P5,P6,TX,TY,TZ
      COMMON /COMP/TRH,DISTX,DISTY,DISTD,DISTS,D21,ZETA4,ZETA4D,ZETA3,
     1             ZETA3D,SFZ1,SNPU,SNTU,HCGH1,HCGH2,HCGH3,HCGH4,TERM1,
     2             TERM2,SNPSU,SNPR,HCBH1,HCBH2,HCBH3,HCBH4,HCAH1,HCAH2,
     3             HCAH3,HCAH4,UQ,WP,UR,QR,VP,PR,P2,Q2,R2,VR,WQ,PQ,PHIR2
     4            ,PHIRD2,RPHRD,GCTH,GSTH,GCTSP,GCTCP,XXX,YYY,IX,IY,XX1,
     5             XX2,YY1,YY2,THG1,THG2,PHG1,PHG2,ZZ1,ZZ2,LLL
      DIMENSION HCAH(4),HCBH(4),HCGH(4)
      EQUIVALENCE (HCAH(1),HCAH1),(HCBH(1),HCBH1),(HCGH(1),HCGH1)
      COMMON /COMPN/ FRSP(4),FRCP(4),ICBHIT,JCBHIT,
     1                DPSINT,TANPC1,TANPC2,PHIC1R,PHIC2R,AMUCMP,PHI1D,
     2                PHI2D,LCB1(4),LCB2(4),IHIT,AJMTX(3,3),BMTX(3,3),
     3                SFRX(4),SFRY(4),SFRZ(4),T1PSI,T2PSI,XMUGI(4)
      LOGICAL LCB1,LCB2
```

```fortran
      COMMON /TIRIN/ AKT(4),SIGT(4),XLAMT(4),A0(4),A1(4),A2(4),A3(4),
     1               A4(4),OMEGT(4),AMU(4),RW(4),FJP(35,4),A234(4),
     2               A12(4),OMT2A2(4),OMT2M1(4),A23(4),ITIR(4)
      COMMON /RUFNES/ DELG,DGMAX,NEND,IRUF
      DIMENSION ZGM(2205)
      DIMENSION FJPP(35)
      DO 20 N=1,35
   20 FJPP(N) = FJP(N,I)
      SNPSI = SIN(PSII(I))
      CSPSI = COS(PSII(I))
      SNPHI = SIN(PHII(I))
      CSPHI = COS(PHII(I))
      SFRX(I) = 0.0
      SFRY(I) = 0.0
      SFRZ(I) = 0.0
      TTAJ21 = CSPHI*SNPSI
      TTAJ31 = SNPHI*SNPSI
      AJMTX(1,2) = -SNPSI
      AJMTX(2,2) = CSPHI*CSPSI
      AJMTX(3,2) = SNPHI*CSPSI
      INDF = 0
      INDL = 0
      MF = IFIX((XP(I)-RW(I))/DELG)
      ML = MF+IFIX(2.0*RW(I)/DELG)
      IF(MF.GE.1) GO TO 10
      MF = 1
      INDF = 1
   10 IF(ML.LE.NEND) GO TO 11
      ML = NEND
      INDL = 1
   11 DO 100 J=1,21
      THTJ = (-44.0+4.0*J)*RAD
      STJ = SIN(THTJ)
      CTJ = COS(THTJ)
      AJMTX(1,1) = CTJ*CSPSI
      AJMTX(2,1) = TTAJ21*CTJ+SNPHI*STJ
      AJMTX(3,1) = TTAJ31*CTJ-CSPHI*STJ
      AJMTX(1,3) = CSPHI*STJ
      AJMTX(2,3) = TTAJ21*STJ-SNPHI*CTJ
      AJMTX(3,3) = TTAJ31*STJ+CSPHI*CTJ
      DO 8 K=1,3
      DO 7 L=1,3
      BMTX(K,L) = 0.0
      DO 6 M=1,3
    6 BMTX(K,L) = BMTX(K,L)+AMTX(K,M)*AJMTX(M,L)
    7 CONTINUE
    8 CONTINUE
      IF(BMTX(3,3).EQ.0.0) GO TO 100
      DO 50 M=MF,ML
      ZM1 = 0.0
      IF(M.LT.NEND) ZM1 = ZGM(M+1)
```

```
      XM = DELG*(M-1)
      XM1 = XM+DELG
      TMP = (BMTX(1,3)*(ZM1-ZGM(M))/(BMTX(3,3)*DELG))
      IF(TMP.EQ.1) GO TO 50
      XD = XM-XP(I)
      XD1 = XM1-XP(I)
      IF(ABS(XD).LT.0.001.OR.ABS(XD1).LT.0.001) GO TO 49
      SM = (ZGM(M)-ZP(I))/XD
      SM1 = (ZM1-ZP(I))/XD1
      SGM = SIGN(1.0,SM)
      SGM1 = SIGN(1.0,SM1)
      IF(SGM.GT.0.0.AND.SGM1.LT.0.0) GO TO 50
      IF(SGM.EQ.SGM1.AND.SM1.GT.SM) GO TO 50
   49 TMP1 = 1.0/(1.0-TMP)
      XJP = TMP1*(XP(I)+BMTX(1,3)*(ZGM(M)-ZP(I)-XM*
     1     (ZM1-ZGM(M))/DELG)/BMTX(3,3))
      IF(XJP.GE.XM) GO TO 60
      IF(XJP.GE.0.0) GO TO 100
      GO TO 69
   60 IF(XJP.LE.XM1) GO TO 70
   50 CONTINUE
      GO TO 69
   70 IF(ABS(BMTX(1,3)).LT.0.0001) GO TO 71
      HJ = (XJP-XP(I))/BMTX(1,3)
      ZJP = ZP(I)+BMTX(3,3)*HJ
      GO TO 72
   71 ZJP = ZGM(M)+(XJP-XM)*(ZM1-ZGM(M))/DELG
      HJ = (ZJP-ZP(I))/BMTX(3,3)
      XJP = XP(I)
      GO TO 72
   69 ZJP = 0.0
      XJP = XP(I)-BMTX(1,3)*ZP(I)/BMTX(3,3)
      HJ = -ZP(I)/BMTX(3,3)
   72 YJP = YP(I)+BMTX(2,3)*HJ
      IF(HJ.LT.0.0.OR.HJ.GT.RW(I)) GO TO 100
      CAJ = (XP(I)-XJP)/HJ
      CBJ = (YP(I)-YJP)/HJ
      CGJ = (ZP(I)-ZJP)/HJ
      CALL INTRPL(FJPP,RWHJB,RWHJE,DRWHJ,RW(I)-HJ,FJ)
      SFRX(I) = SFRX(I)+FJ*CAJ
      SFRY(I) = SFRY(I)+FJ*CBJ
      SFRZ(I) = SFRZ(I)+FJ*CGJ
  100 CONTINUE
      FR(I) = SQRT(SFRX(I)**2+SFRY(I)**2+SFRZ(I)**2)
      IF(FR(I).NE.0.0) GO TO 110
      CAR(I) = 0.0
      CBR(I) = 0.0
      CGR(I) = 1.0
      HI(I) = RW(I)
      PHGI(I) = 0.0
      THGI(I) = 0.0
```

```
      SPG(I) = 0.0
      TXGP = XP(I)
      GO TO 112
  110 CAR(I) = -SFRX(I)/FR(I)
      CBR(I) = -SFRY(I)/FR(I)
      CGR(I) = -SFRZ(I)/FR(I)
      HI(I) = RW(I)-FR(I)/AKT(I)
      IF(HI(I).GT.RW(I)-SIGT(I)) GO TO 111
      HI(I) = RW(I)-(FR(I)/AKT(I)+SIGT(I)*(XLAMT(I)-1.0))/XLAMT(I)
  111 TXGP = XP(I)+HI(I)*CAR(I)
      ME = TXGP/DELG+1
      TPHGI = 0.0
      TTHGI = ATAN2((ZGM(ME)-ZGM(ME+1)),DELG)
      TAI = CBR(I)*CGYW(I)-CGR(I)*CBYW(I)
      TBI = CGR(I)*CAYW(I)-CAR(I)*CGYW(I)
      TCI = CAR(I)*CBYW(I)-CBR(I)*CAYW(I)
      STI = SIN(TTHGI)
      CTI = COS(TTHGI)
      DN1 = (TCI*TCI+TBI*TBI)*STI-TAI*TCI*CTI
      DN2 = -TBI*(TAI*STI+TCI*CTI)
      DN3 = (TAI*TAI+TBI*TBI)*CTI-TAI*TCI*STI
      TERM5 = SQRT(DN1*DN1+DN2*DN2+DN3*DN3)
      SPG(I) = -DN2/TERM5
      PHGI(I) = ARSIN(SPG(I))
      THGI(I) = ATAN(DN1/DN3)
  112 CPG(I) = COS(PHGI(I))
      CTG(I) = COS(THGI(I))
      STG(I) = SIN(THGI(I))
      XGPP(I) = TXGP
      YGPP(I) = YP(I)+HI(I)*CBR(I)
      ZGPP(I) = ZP(I)+HI(I)*CGR(I)
      RETURN
      END
```

```
      SUBROUTINE RUFRED(NEND,DELG,DGMAX,ZRTAB)
C             HVOSM-VD2 VERSION
C             REVISED OCTOBER 1975   CALSPAN CORPORATION
C             HVOSM-RD2 VERSION
C          HVOSM-VD2 VERSION
C             REVISED OCTOBER 1975  CALSPAN CORPORATION
      DIMENSION ZRTAB(2205)
      IF(NEND.GT.2200) GO TO 900
      READ(4,END=901) (ZRTAB(I),I=1,NEND)
      GO TO 12
  901 WRITE(6,9001)
 9001 FORMAT('     END OF FILE ENCOUNTERED IN READ OF ROUGHNESS '/
     1   '  DATA BEFORE NEND POINTS WERE READ.'  )
      NEND = I
   12 DGMAX = (NEND-1)*DELG
      RETURN
  900 WRITE(6,9000)
 9000 FORMAT('     NUMBER OF LAST ROUGHNESS DATA POINT IS GREATER '/
     1   ' THAN THE ALLOWED 2200.  PROGRAM TERMINATED.'  )
      STOP
      END
```

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      SUBROUTINE SFORCE                                                 SFOR0010
C           HVOSM-RD2 VERSION                                           SFOR0020
C           REVISED OCTOBER 1975   CALSPAN CORPORATION                  SFOR0030
      COMMON /INTG/NEQ,T,DT,VAR(50),DER(50)                             SFOR0040
      EQUIVALENCE (U,VAR(1)),(V,VAR(2)),(W,VAR(3)),(P,VAR(4)),(Q,VAR(5))SFOR0050
     1          ,(R,VAR(6)),(DEL1,VAR(7)),(DEL1D,VAR(8)),(DEL2,VAR(9)),SFOR0060
     2           (DEL2D,VAR(10)),(DEL3,VAR(11)),(DEL3D,VAR(12)),        SFOR0070
     3           (PHIR,VAR(13)),(PHIRD,VAR(14)),(THETTP,VAR(15)),       SFOR0080
     4           (PHITP,VAR(16)),(PSITP,VAR(17)),(XCP,VAR(18)),         SFOR0090
     5           (YCP,VAR(19)),(ZCP,VAR(20)),(PSIFI,VAR(21)),           SFOR0100
     6           (PSIFID,VAR(22))                                       SFOR0110
      EQUIVALENCE (DU,DER(1)),(DV,DER(2)),(DW,DER(3)),(DP,DER(4)),      SFOR0120
     1           (DQ,DER(5)),(DR,DER(6)),(DDEL1,DER(7)),(DDEL1D,DER(8)))SFOR0130
     2          ,(DDEL2,DER(9)),(DDEL2D,DER(10)),(DDEL3,DER(11)),       SFOR0140
     3           (DDEL3D,DER(12)),(DPHIR,DER(13)),(DPHIRD,DER(14)),     SFOR0150
     4           (DTHTTP,DER(15)),(DPHITP,DER(16)),(DPSITP,DER(17)),    SFOR0160
     5           (DXCP,DER(18)),(DYCP,DER(19)),(DZCP,DER(20)),          SFOR0170
     6           (DPSIFI,DER(21)),(DDPSFI,DER(22))                      SFOR0180
      EQUIVALENCE (VAR(9),PHIF),(VAR(10),PHIFD),(DER(9),DPHIF),         SFOR0190
     1           (DER(10),DPHIFD)                                       SFOR0200
      EQUIVALENCE (VAR(13),DEL4),(VAR(14),DEL4D),(DER(13),DDEL4),       SFOR0210
     1           (DER(14),DDEL4D)                                       SFOR0220
      COMMON /DIMV/X1P,X2P,X3P,X4P,Y1P,Y2P,Y3P,Y4P,Z1P,Z2P,Z3P,Z4P,PHI1,SFOR0230
     1            PHI2,PHI3,PHI4,PSI1,PSI2,PSI3,PSI4,CAYW(4),CBYW(4),   SFOR0240
     2            CGYW(4),ZPGI(4),THGI(4),PHGI(4),CPG(4),SPG(4),CTG(4),SFOR0250
     3            STG(4),CAGZ(4),CBGZ(4),CGGZ(4),D1(4),D2(4),D3(4),     SFOR0260
     4            XLM1(4),XLM2(4),XLM3(4),AMTX(3,3),CMTX(3,4),XGPP(4),  SFOR0270
     5            YGPP(4),ZGPP(4),DMATX(10,11),DELTA(4),CAR(4),CBR(4),  SFOR0280
     6            CGR(4),FR(4),HI(4),FC(4),TI(4),AX(4),BX(4),CX(4),     SFOR0290
     7            CTXG(4),UG(4),STXG(4),AY(4),BY(4),CY(4),CPYG(4),      SFOR0300
     8            SPYG(4),VG(4),PSIIP(4),PHICI(4),CAC(4),CBC(4),CGC(4),SFOR0310
     9            FCXU(4),FCYU(4),FCZU(4),FS(4),CAXW(4),CBXW(4),CGXW(4)SFOR0320
      COMMON /DIMV/AS(4),BS(4),CS(4),CAS(4),CBS(4),CGS(4),BETP(4),      SFOR0330
     1            BETBR(4),FSXU(4),FSYU(4),FSZU(4),FRXU(4),FRYU(4),     SFOR0340
     2            FRZU(4),FXU(4),FYU(4),FZU(4),SI(4),F1FI(2),F1RI(2),   SFOR0350
     3            F2FI(2),F2RI(2),CAH(4),CBH(4),CGH(4)                  SFOR0360
      DIMENSION XP(4),YP(4),ZP(4),PHII(4),PSII(4)                       SFOR0370
      EQUIVALENCE (XP(1),X1P),(YP(1),Y1P),(ZP(1),Z1P),(PHII(1),PHI1),   SFOR0380
     1           (PSII(1),PSI1)                                         SFOR0390
      COMMON /COMP/SUMM,THETN,PHIN,PSIN,PI,RAD,GAM1,GAM2,GAM3,GAM4,GAM5,SFOR0400
     1           GAM6,GAM7,GAM8,GAM9,THETT,PHIT,PSIT,ZRO,TRO2,          SFOR0410
     2            TFO2,TIZ,RHO2,RHOMUR,AMUF,BMUR,ZPR,TM4,RHMR2,AO2APB,  SFOR0420
     3            BO2APB,RFTF,TSO2,RRTS,BROMUR,XMUFO2,AXMFO2,XMTFO4,    SFOR0430
     4            XIZR,RTR,RHMR2I,XIXP,XIZP,XIXZP,XIYZP,D1PD2,D1MD2,    SFOR0440
     5            ZRD3,ZRD3R,ZFD3R,ZFD12,TIZ2,TG61,DD1P2,DD1M2,RPR,PHRPSFOR0450
     6           ,TANTP,SPHTP,CPHTP,SECTP,SFXS,SFYS,SFZS,SNPS,SNTS,     SFOR0460
     7            SNPSS,TPR,CAY,CBY,CGY,CAX,CBX,CGX,SFYU,SFXU,SFYUF,    SFOR0470
     8            SFYUR,SFZU,COSTH,SINTH,COSPS,SINPS,COSPH,SINPH,ANG1,  SFOR0480
     9            ANG2,CPHI,SPHI,CPSI,SPSI,P1,P7,P3,P4,P5,P6,TX,TY,TZ   SFOR0490
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      COMMON /COMP/TRH,DISTX,DISTY,DISTD,DISTS,D21,ZETA4,ZETA4D,ZETA3,
     1             ZETA3D,SFZ1,SNPU,SNTU,HCGH1,HCGH2,HCGH3,HCGH4,TERM1,
     2             TERM2,SNPSU,SNPR,HCBH1,HCBH2,HCBH3,HCBH4,HCAH1,HCAH2,
     3             HCAH3,HCAH4,UQ,WP,UR,QR,VP,PR,P2,Q2,R2,VR,WQ,PQ,PHIR2
     4            ,PHIRD2,RPHRD,GCTH,GSTH,GCTSP,GCTCP,XXX,YYY,IX,IY,XX1,
     5             XX2,YY1,YY2,THG1,THG2,PHG1,PHG2,ZZ1,ZZ2,LLL
      DIMENSION HCAH(4),HCBH(4),HCGH(4)
      EQUIVALENCE (HCAH(1),HCAH1),(HCBH(1),HCBH1),(HCGH(1),HCGH1)
      COMMON /COMPN/ FRSP(4),FRCP(4),ICBHIT,JCBHIT,
     1               DPSINT,TANPC1,TANPC2,PHIC1R,PHIC2R,AMUCMP,PHI1D,
     2               PHI2D,LCB1(4),LCB2(4),IHIT,AJMTX(3,3),BMTX(3,3),
     3               SFRX(4),SFRY(4),SFRZ(4),T1PSI,T2PSI,XMUGI(4)
      LOGICAL LCB1,LCB2
      COMMON /INPT2/ YBPO,ZBTP,ZBBP,XVF,XVR,YV,ZVT,ZVB,AKV,SIGR(11),
     1               SET,CONS,AMUB,EPSV,EPSB,XM,EPST,DDD,INDB,DELYBP,
     2               DELTB,XINPT(100)
      COMMON/BARIER/FN,IBHIT,JBHIT,XCPNP(3),YCPNP(3),ZCPNP(3),XCPN(3),
     1              YCPN(3),ZCPN(3),AA1(17),BB1(17),CC1(17),RR1(17),
     2              AA2(17),BB2(17),CC2(17),RR2(17),CAB,CBB,CGB,CABT,
     3              CBBT,CGBT,RB,XBT,YBT,ZBT,XBB,YBB,ZBB,RR2P(17),
     4              YBPT,XNN(17),YNN(17),ZNN(17),XMTX(3,4),IDPT(17),IPT
     5              ,ININD,UNP(17),VNP(17),WNP(17),VMAX(4),I1,I2,I3,I4,
     6              XCPTP,YCPTP,ZCPTP,XCPBP,YCPBP,ZCPBP,YCPMP,AINTI,
     7              AINTP,SXR,SYR,SZR,SDEN,XRI,YRI,ZRI,FRICT,DELBB,VTAN,
     8              FNP,FB,URP,VRP,WRP,EPSL,XLDP,DELX,VL,NCYC,EEE,ENRGY,
     9              NSEG,YBPTP,PCAB,PCBB,PCGB,PPRB,CAB1,CBB1,CGB1,
     A              RB1,NUNLD,NLDCTR,VDEF,PVDEF,PSZR,XF,DELBBP,
     B              SWORK,SPENGY,DISS,IPLN,ILOAD
      DIMENSION INDXPT(4)
      EQUIVALENCE (INDXPT(1),I1)
      COMMON/BARSTR/ XSTIO(3),YSTIO(3),ZSTIO(3),XSTI(3),YSTI(3),
     1               ZSTI(3),YSTIPO(3),XSTIP(3),YSTIP(3),ZSTIP(3),
     2               FNSTI(3),AKST(3)
      COMMON /HARDPT/ FRICF(4),UPT(4),VPT(4),WPT(4)
    1 SFXS = 0.0
      YBP = 0.0
      SFYS = 0.0
      SFZS = 0.0
      SNPS = 0.0
      SNTS = 0.0
      SNPSS = 0.0
      FN = 0.0
      IBHIT = 0
      IPLN = 0
      NAXIS = 0
      FRICT = 0.0
      VTAN = 0.0
      VMAX(1) = 0.0
      NSLCE = 0
      NUNLD = 0
      NUNLD2 = 0
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```
      YB1VF = 0.0
      IF(INDB.EQ.0) RETURN
      IB = (INDB+1)/2
    2 DO 3  I=1,3
      XCPNP(I) = XCP+AMTX(1,1)*XCPN(I)+AMTX(1,2)*YCPN(I)+AMTX(1,3)*
     1           ZCPN(I)
      YCPNP(I) = YCP+AMTX(2,1)*XCPN(I)+AMTX(2,2)*YCPN(I)+AMTX(2,3)*
     1           ZCPN(I)
      ZCPNP(I) = ZCP+AMTX(3,1)*XCPN(I)+AMTX(3,2)*YCPN(I)+AMTX(3,3)*
     1           ZCPN(I)
      YSTIPO(I) = YCP+AMTX(2,1)*XSTIO(I)+AMTX(2,2)*YSTIO(I)
     1           +AMTX(2,3)*ZSTIO(I)
    3 CONTINUE
      YPMAX = -1.0E30
    4 DO 5  I=1,3
      IF(YCPNP(I).LT.YPMAX) GO TO 5
      YPMAX = YCPNP(I)
      NDX = I
    5 CONTINUE
      XCPTP = XCP+AMTX(1,1)*XCPN(NDX)+AMTX(1,2)*YCPN(NDX)+AMTX(1,3)*ZVT
      YCPTP = YCP+AMTX(2,1)*XCPN(NDX)+AMTX(2,2)*YCPN(NDX)+AMTX(2,3)*ZVT
      ZCPTP = ZCP+AMTX(3,1)*XCPN(NDX)+AMTX(3,2)*YCPN(NDX)+AMTX(3,3)*ZVT
      XCPBP = XCP+AMTX(1,1)*XCPN(NDX)+AMTX(1,2)*YCPN(NDX)+AMTX(1,3)*ZVB
      YCPBP = YCP+AMTX(2,1)*XCPN(NDX)+AMTX(2,2)*YCPN(NDX)+AMTX(2,3)*ZVB
      ZCPBP = ZCP+AMTX(3,1)*XCPN(NDX)+AMTX(3,2)*YCPN(NDX)+AMTX(3,3)*ZVB
    6 YCPMP = AMAX1(YCPTP,YCPBP)
      IF(YBPO-YCPMP.LT.5.0) IBHIT=1
      VDEF = AMAX1(YCPMP-YBPTP,0.0)
      IF(VDEF.LT.2.0*DELYBP) GO TO 41
      IF(MOD(INDB,2).EQ.0) GO TO 8
    7 CABT = AMTX(3,1)
      CBBT = AMTX(3,2)
      CGBT = AMTX(3,3)
      TMP = ZBTP-ZCP
      XBT = -AMTX(1,1)*XCP-AMTX(2,1)*YCP+AMTX(3,1)*TMP
      YBT = -AMTX(1,2)*XCP-AMTX(2,2)*YCP+AMTX(3,2)*TMP
      ZBT = -AMTX(1,3)*XCP-AMTX(2,3)*YCP+AMTX(3,3)*TMP
      RBT = XBT*CABT+YBT*CBBT+ZBT*CGBT
      TMP = ZBBP-ZCP
      XBB = -AMTX(1,1)*XCP-AMTX(2,1)*YCP+AMTX(3,1)*TMP
      YBB = -AMTX(1,2)*XCP-AMTX(2,2)*YCP+AMTX(3,2)*TMP
      ZBB = -AMTX(1,3)*XCP-AMTX(2,3)*YCP+AMTX(3,3)*TMP
      RBB = XBB*CABT+YBB*CBBT+ZBB*CGBT
    8 CAB = AMTX(2,1)
      CBB = AMTX(2,2)
      CGB = AMTX(2,3)
      TMP = YBPTP-YCP
      IF(ININD.LT.2.OR.CAB*PCBB.EQ.CBB*PCAB) GO TO 80
      XBPP = -AMTX(1,1)*XCP+AMTX(2,1)*TMP-AMTX(3,1)*ZCP
      YBPP = -AMTX(1,2)*XCP+AMTX(2,2)*TMP-AMTX(3,2)*ZCP
      ZBPP = -AMTX(1,3)*XCP+AMTX(2,3)*TMP-AMTX(3,3)*ZCP
```

```
      RBPP = XBPP*CAB+YBPP*CBB+ZBPP*CGB
      XMTX(1,1) = CAB
      XMTX(1,2) = CBB
      XMTX(1,3) = CGB
      XMTX(1,4) = RBPP
      XMTX(2,1) = PCAB
      XMTX(2,2) = PCBB
      XMTX(2,3) = PCGB
      XMTX(2,4) = PPRB
      XMTX(3,1) = 0
      XMTX(3,2) = 0
      XMTX(3,3) = 1
      XMTX(3,4) = PSZR
      CALL SIMSOL(XMTX,3,3)
      XB1 = XMTX(1,4)
      YB1 = XMTX(2,4)
      ZB1 = XMTX(3,4)
      IF (XVR.LE.XB1.AND.XB1.LE.XVF.AND.ABS(YB1).LT.YV.AND.ZVT.LE.ZB1
     1.AND.ZB1.LE.ZVB) NAXIS = 1
      IF(NAXIS.EQ.0.AND.VDEF.LT.PVDEF.AND.XB1.LT.XVR) GO TO 41
      TMPA = CBB*PCGB-CGB*PCBB
      TMPB = CGB*PCAB-CAB*PCGB
      TMPC = CAB*PCBB-CBB*PCAB
      TMPAP = TMPB*CGB-TMPC*CBB
      TMPBP =-TMPC*CAB+TMPA*CGB
      TMPCP =-TMPA*CBB+TMPB*CAB
      TMPD = SQRT(TMPAP**2+TMPBP**2+TMPCP**2)
      CAB1 = TMPAP/TMPD
      CBB1 = TMPBP/TMPD
      CGB1 = TMPCP/TMPD
      RB1 = XB1*CAB1+YB1*CBB1+ZB1*CGB1
      YB1VF = 1.0E6
      IF(CBB1.NE.0.) YB1VF=(RB1-XVF*CAB1)/CBB1
   78 DO 79 I=12,17
      AA2(I) = CAB1
      BB2(I) = CBB1
      CC2(I) = CGB1
      RR2(I) = RB1
   79 CONTINUE
C   PRESENT LOCATION OF HARDPOINTS IN SPACE FIXED COORDINATES
   80 DO 81 I=1,3
      XSTIP(I)=XCP+AMTX(1,1)*XSTI(I)+AMTX(1,2)*YSTI(I)+AMTX(1,3)*ZSTI(I)
      YSTIP(I)=YCP+AMTX(2,1)*XSTI(I)+AMTX(2,2)*YSTI(I)+AMTX(2,3)*ZSTI(I)
      ZSTIP(I)=ZCP+AMTX(3,1)*XSTI(I)+AMTX(3,2)*YSTI(I)+AMTX(3,3)*ZSTI(I)
   81 CONTINUE
      XRI = 0.0
      YRI = 0.0
      ZRI = 0.0
      AINTI = 0.0
      SXR = 0.0
      SYR = 0.0
```

```
      SZR = 0.0                                                         SFOR2030
      SDEN = 0.0                                                        SFOR2040
      FNX = 0.0                                                         SFOR2050
      FNX1 = 0.0                                                        SFOR2060
      FB = 0.0                                                          SFOR2070
      FBFN = 0.0                                                        SFOR2080
      SFNST = 0.0                                                       SFOR2090
      NSEG = (YCPMP-YBPTP)/DELYBP+1.0                                   SFOR2100
      IPLN = NSEG                                                       SFOR2110
      YBP = YBPTP+IPLN*DELYBP                                           SFOR2120
      NSG111 = NSEG+1                                                   SFOR2130
      I111 = 1                                                          SFOR2140
    9 DO 38 I=I111,NSG111                                               SFOR2150
      IPLNP = IPLN                                                      SFOR2160
      PYBP = YBP                                                        SFOR2170
      PDELBB = DELBB                                                    SFOR2180
      PPSXR = SXR                                                       SFOR2190
      PPSYR = SYR                                                       SFOR2200
      PPSZR = SZR                                                       SFOR2210
      PSDEN = SDEN                                                      SFOR2220
      PFNX = FNX                                                        SFOR2230
      PFNX1 = FNX1                                                      SFOR2240
      PFB = FB                                                          SFOR2250
      PFBFN = FBFN                                                      SFOR2260
      PSFNST = SFNST                                                    SFOR2270
      SFNST = 0.                                                        SFOR2280
      IPLN = NSEG-I+1                                                   SFOR2290
      YBP = YBPTP+IPLN*DELYBP                                           SFOR2300
      IF(YBP.LT.YBPO+EPSL+SET*DELX)GO TO 40                             SFOR2310
      TMP = YBP-YCP                                                     SFOR2320
      XBI = -AMTX(1,1)*XCP+AMTX(2,1)*TMP-AMTX(3,1)*ZCP                  SFOR2330
      YBI = -AMTX(1,2)*XCP+AMTX(2,2)*TMP-AMTX(3,2)*ZCP                  SFOR2340
      ZBI = -AMTX(1,3)*XCP+AMTX(2,3)*TMP-AMTX(3,3)*ZCP                  SFOR2350
      RBI = XBI*CAB+YBI*CBB+ZBI*CGB                                     SFOR2360
      IPT = 0                                                           SFOR2370
   10 DO 15  J=1,17                                                     SFOR2380
      IDPT(J) = 0                                                       SFOR2390
      IF(PSIT.LE.0.0.AND.J.LE.2)GO TO 15                                SFOR2400
      IF(ININD.LT.2.AND.J.GT.11) GO TO 15                               SFOR2410
      IF(CAB.EQ.0..AND.(J.EQ.4.OR.J.EQ.5.OR.J.EQ.10.OR.J.EQ.11))GO TO 15SFOR2420
      IF(CBB.EQ.0..AND.(J.LE.2.OR.J.EQ.7.OR.J.EQ.8)) GO TO 15           SFOR2430
      IF(CGB.EQ.0..AND.(J.EQ.3.OR.J.EQ.6.OR.J.EQ.9)) GO TO 15           SFOR2440
      IF(CAB1*CBB.EQ.CBB1*CAB.AND.(J.EQ.12.OR.J.EQ.13)) GO TO 15        SFOR2450
      IF(CBB1*CGB.EQ.CGB1*CBB.AND.(J.EQ.14.OR.J.EQ.15)) GO TO 15        SFOR2460
      IF(CGB1*CAB.EQ.CAB1*CGB.AND.J.GE.16) GO TO 15                     SFOR2470
      IF(NAXIS.EQ.0.AND.J.GT.11) GO TO 15                               SFOR2480
   11 XMTX(1,1) = CAB                                                   SFOR2490
      XMTX(1,2) = CBB                                                   SFOR2500
      XMTX(1,3) = CGB                                                   SFOR2510
      XMTX(1,4) = RBI                                                   SFOR2520
   12 XMTX(2,1) = AA1(J)                                                SFOR2530
```

```
      XMTX(2,2) = BB1(J)
      XMTX(2,3) = CC1(J)
      XMTX(2,4) = RR1(J)
   13 XMTX(3,1) = AA2(J)
      XMTX(3,2) = BB2(J)
      XMTX(3,3) = CC2(J)
      XMTX(3,4) = RR2(J)
   14 CALL SIMSOL(XMTX,3,3)
      XNN(J) = XMTX(1,4)
      YNN(J) = XMTX(2,4)
      ZNN(J) = XMTX(3,4)
      IF(XNN(J).LT.XVR.OR.XNN(J).GT.XVF) GO TO 15
      IF(ABS(YNN(J)).GT.YV) GO TO 15
      IF(ZNN(J).LT.ZVT.OR.ZNN(J).GT.ZVB) GO TO 15
      IDPT(J) = 1
      IPT = IPT+1
      IPPT = J
   15 CONTINUE
      IF(IPPT.LE.11.AND.(NAXIS.EQ.1.AND.YB1VF.GT.YV.AND.ININD.EQ.2))
     1 GO TO 38
      IF(MOD(INDB,2).EQ.0) GO TO 23
      IF(CGB.EQ.0.0.AND.CGBT.EQ.0.0)GO TO 23
      RR2P(1) = RBT
      RR2P(2) = RBB
      RR2P(4) = RBT
      RR2P(5) = RBB
      RR2P(7) = RBT
      RR2P(8) = RBB
      RR2P(10) = RBT
      RR2P(11) = RBB
      RR2P(12) = RBT
      RR2P(13) = RBB
      RR2P(14) = RBT
      RR2P(15) = RBB
      RR2P(16) = RBT
      RR2P(17) = RBB
   16 DO 22  J=1,17
      IF(PSIT.LE.0.0.AND.J.LE.2)GO TO 22
      IF(J.EQ.3.OR.J.EQ.6.OR.J.EQ.9) GO TO 22
      IF(CAB*CGBT.EQ.CGB*CABT.AND.(J.EQ.4.OR.J.EQ.5.OR.J.EQ.10.OR.
     1   J.EQ.11)) GO TO 22
      IF(CGB*CBBT.EQ.CBB*CGBT.AND.(J.LE.2.OR.J.EQ.7.OR.J.EQ.8)) GO TO 22
      IF(CAB*(CBB1*CGBT-CBBT*CGB1)-CAB1*(CBB*CGBT-CBBT*CGB)+CABT*(CBB*
     1   CGB1-CBB1*CGB).EQ.0.0.AND.J.GE.12) GO TO 22
      IF(J.GE.12.AND.IDPT(J).NE.1) GO TO 22
      IF(IDPT(1).EQ.1.AND.IDPT(2).EQ.1.AND.J.EQ.14) GO TO 173
      IF(IDPT(7).EQ.1.AND.IDPT(8).EQ.1.AND.J.EQ.15) GO TO 173
      IF(IDPT(4).EQ.1.AND.IDPT(5).EQ.1.AND.J.EQ.16) GO TO 173
      IF(IDPT(10).EQ.1.AND.IDPT(11).EQ.1.AND.J.EQ.17) GO TO 173
      XMTX(1,1) = CAB
      XMTX(1,2) = CBB
```

```
      XMTX(1,3) = CGB
      XMTX(1,4) = RBI
      IF(J.GE.12) GO TO 170
      XMTX(2,2) = BB1(J)
      XMTX(2,3) = CC1(J)
   17 XMTX(2,1) = AA1(J)
      XMTX(2,4) = RR1(J)
      GO TO 18
  170 XMTX(2,1) = AA2(J)
      XMTX(2,2) = BB2(J)
      XMTX(2,3) = CC2(J)
      XMTX(2,4) = RR2(J)
   18 XMTX(3,1) = CABT
      XMTX(3,2) = CBBT
      XMTX(3,3) = CGBT
      IF((IDPT(1).EQ.1.AND.J.EQ.14).OR.(IDPT(4).EQ.1.AND.J.EQ.16))
     1 GO TO 171
      IF((IDPT(8).EQ.1.AND.J.EQ.15).OR.(IDPT(11).EQ.1.AND.J.EQ.17))
     1 GO TO 172
      XMTX(3,4) = RR2P(J)
      GO TO 19
  171 XMTX(3,4) = RBB
      GO TO 19
  172 XMTX(3,4) = RBT
   19 CALL SIMSOL(XMTX,3,3)
      IF(XMTX(1,4).LT.XVR.OR.XMTX(1,4).GT.XVF) GO TO 22
      IF(ABS(XMTX(2,4)).GT.YV) GO TO 22
      IF(XMTX(3,4).LT.ZVT.OR.XMTX(3,4).GT.ZVB) GO TO 22
      IF(IDPT(J).NE.0) GO TO 20
      IDPT(J) = 1
      GO TO 21
   20 IF(ABS(XMTX(3,4)).GE.ABS(ZNN(J)))GO TO 22
   21 XNN(J) = XMTX(1,4)
      YNN(J) = XMTX(2,4)
      ZNN(J) = XMTX(3,4)
      GO TO 22
  173 IDPT(J) = 0
      IPT = IPT-1
   22 CONTINUE
   23 IF(IPT.LT.3) GO TO 38
   24 DO 25  J=1,17
      IF(IDPT(J).EQ.0) GO TO 25
      TMPU = U-YNN(J)*R+ZNN(J)*Q
      TMPV = V+XNN(J)*R-ZNN(J)*P
      TMPW = W+YNN(J)*P-XNN(J)*Q
      UNP(J) = AMTX(1,1)*TMPU+AMTX(1,2)*TMPV+AMTX(1,3)*TMPW
      VNP(J) = AMTX(2,1)*TMPU+AMTX(2,2)*TMPV+AMTX(2,3)*TMPW
      WNP(J) = AMTX(3,1)*TMPU+AMTX(3,2)*TMPV+AMTX(3,3)*TMPW
   25 CONTINUE
   26 DO 27  J=1,4
      VMAX(J) = -1.0E30
```

```
      INDXPT(J) = 0
   27 CONTINUE
   28 DO 34  J=1,17
      IF(IDPT(J).EQ.0) GO TO 34
   29 DO 33  K=1,4
      IF(VNP(J).LT.VMAX(K)) GO TO 33
      IF(K.EQ.4) GO TO 32
      K1 = K+1
   30 DO 31  L=K1,4
      M = 4-L+K1
      VMAX(M) = VMAX(M-1)
      INDXPT(M) = INDXPT(M-1)
   31 CONTINUE
   32 VMAX(K) = VNP(J)
      INDXPT(K) = J
      GO TO 34
   33 CONTINUE
   34 CONTINUE
      IPT = 4
      IF(INDXPT(4).EQ.0) IPT = 3
   37 J3 = I3
      J1 = I1
      J2 = I2
      J4 = I4
      CALL AREA
      DO 91 IJ = 1,3
      FNSTI(IJ) = 0.0
      IF(VPT(IJ+1).GE.0.0.AND.YSTIPO(IJ).GE.YBP) FNSTI(IJ) =
     1         AKST(IJ)*(YSTIPO(IJ)-YBP)
      SFNST = SFNST+FNSTI(IJ)
   91 CONTINUE
      IF(IB.EQ.1) GO TO 38
      FNX1 = AKV*DELYBP*SDEN
      FNX = FNX1+SFNST
      IF(NSLCE.NE.0) GO TO 38
   40 DELBB = AMAX1(YBP-YBPO,EPSL+SET*DELX)
      CALL NLDFRC
      FBFN = FB-FNX
      IF(EPSB.LT.FBFN) GO TO 38
      IF(I.EQ.1) GO TO 105
      IF(FBFN.GE.0.0)  GO TO 105
      IF(ABS(FBFN).LT.ABS(PFBFN)) GO TO 105
      WRITE(6,1001) T,I,YBP,PYBP,FNX,PFNX
 1001 FORMAT(4H  T=,F7.4,3H I=,I3,5H YBP=,F10.4,6H PYBP=,F10.4,
     1        5H FNX=,G13.5,6H PFNX=,G13.5,27HEQUILIB AT PREV SLICE RESET
     2        )
      IPLN = IPLNP
      YBP = PYBP
      DELBB = PDELBB
      SXR = PPSXR
      SYR = PPSYR
```

```
      SZR = PPSZR
      SDEN = PSDEN
      FNX = PFNX
      FNX1 = PFNX1
      FB = PFB
      SFNST = PSFNST
  105 YBPT = AMAX1(YBP,YBPO+EPSL+SET*DELX)
      NSLCE = NSLCE+1
      IF(NLDCTR.EQ.3)CALL NLDFL
      NUNLD2 = 0
      IF(NUNLD.EQ.0) GO TO 38
      NUNLD2 = 1
      GO TO 110
   38 CONTINUE
  110 DO 111 IJ=1,3
      IF(YSTIP(IJ).GT.YBPT) YSTIP(IJ) = YBPT
      AA = XSTIP(IJ)-XCP
      BB = YSTIP(IJ)-YCP
      CC = ZSTIP(IJ)-ZCP
      XSTI(IJ) = AMTX(1,1)*AA+AMTX(2,1)*BB+AMTX(3,1)*CC
      YSTI(IJ) = AMTX(1,2)*AA+AMTX(2,2)*BB+AMTX(3,2)*CC
      ZSTI(IJ) = AMTX(1,3)*AA+AMTX(2,3)*BB+AMTX(3,3)*CC
  111 CONTINUE
      IF(NUNLD2.NE.0) GO TO 103
      IF(NUNLD.NE.0) GO TO 100
      IF( IB .NE. 1)  GO TO 50
   45 NEGPT=0
      DO 46  J=1,IPT
      IF( VMAX(J) .LT.  0.0 )  NEGPT=NEGPT + 1
   46 CONTINUE
      IF( NEGPT .GE. IPT) GO TO 41
   50 FN = AKV*DELYBP*SDEN
      FN1 = FN+SFNST
      IF(ININD.EQ.0) ININD = 1
      IF(FN1.NE.0.0.AND.NUNLD.EQ.0) CALL RESFRC
      IF(NSLCE.EQ.0.AND.IB.EQ.1) GO TO 103
      IF(NSLCE.EQ.0) GO TO 100
  103 TMP = YBPT-YCP
      NUNLD2 = 0
      XBPP = -AMTX(1,1)*XCP+AMTX(2,1)*TMP-AMTX(3,1)*ZCP
      YBPP = -AMTX(1,2)*XCP+AMTX(2,2)*TMP-AMTX(3,2)*ZCP
      ZBPP = -AMTX(1,3)*XCP+AMTX(2,3)*TMP-AMTX(3,3)*ZCP
      RB = XBPP*CAB + YBPP*CBB + ZBPP*CGB
      GO TO 39
  100 IF(YBP.GT.YBPO) GO TO 250
      YBPT = YBPO
      FB = 0.0
      GO TO 103
  250 NUNLD = NUNLD+1
      NSG111 = NSG111+1
      I111 = NSG111
```

```
      GO TO 9
   39 NUNLD = 0
   41 IF(NLDCTR.EQ.3.AND.IPT.GE.3)WRITE(6,1000)T,XB1,YB1,IPT,J1,J2,J3,
     1          J4,XNN(J1),YNN(J1),ZNN(J1),XNN(J2),YNN(J2),ZNN(J2),
     2              XNN(J3),YNN(J3),ZNN(J3),XNN(J4),YNN(J4),ZNN(J4)
 1000 FORMAT(F7.4,2F7.1,5I3,12F8.1)
      NLDCTR = NLDCTR+1
      RETURN
      END
```

```
      SUBROUTINE SIMSOL (A,KK,LL)
C***********************************************************************
C*                                                                     *
C*    SUBROUTINE SIMSOL      (SINGLE PRECISION VERSION)                *
C*                                                                     *
C*    AUTHOR                                                           *
C*       DR.JOHN T. FLECK                                              *
C*       (REVISED BY F.E. BUTLER)                                      *
C*                                                                     *
C*    REFERENCE                                                        *
C*       ''SUBROUTINES TO SOLVE AN INDEPENDENT SET OF LINEAR           *
C*       SIMULTANEOUS ECUATIONS''  HS/FEB/PAW-84, 21 JULY 1965.        *
C*                                                                     *
C*    PURPOSE                                                          *
C*       TO SOLVE A SET OF SIMULTANEOUS LINEAR EQUATIONS, AX=B.        *
C*                                                                     *
C*    USAGE                                                            *
C*       CALL SIMSOL (A,N,ND1)                                         *
C*                                                                     *
C*    DESCRIPTION OF PARAMETERS                                        *
C*       A - IS A 2-DIMENSIONAL (ND1*ND2) MATRIX OF COEFFICIENTS.      *
C*       N - IS THE NUMBER OF EQUATIONS AND UNKNOWNS.                  *
C*       ND1 - IS THE FIRST DIMENSION OF A IN CALLING PROGRAM.         *
C*            ( ND1.GE.N  AND  ND2.GE.N+1 )                            *
C*                                                                     *
C*    CALLING PROGRAM SETUP                                            *
C*       A(I,J) FOR I,J=1,N                                            *
C*       A(I,N+1)=B(I) FOR I=1,N                                       *
C*       THE SOLUTION IS RETURNED IN COLUMN N+1 OF MATRIX A.           *
C*       MATRIX A IS DESTROYED BY THE SUBROUTINE.                      *
 1000 CONTINUE
C*    REMARKS                                                          *
C*       IF MATRIX A IS SINGULAR, AN ERROR MESSAGE IS PRINTED          *
C*       AND THE JOB IS TERMINATED.                                    *
C*                                                                     *
C*    METHOD                                                           *
C*       SOLUTION IS OBTAINED BY ELIMINATION USING LARGEST PIVOTAL     *
C*       DIVISOR OF EACH COLUMN. EACH STAGE OF ELIMINATION CONSISTS    *
C*       OF INTERCHANGING ROWS WHEN NECESSARY TO AVOID DIVISION BY     *
C*       ZERO OR SMALL NUMBERS.                                        *
C*       THE FORWARD SOLUTION TO OBTAIN VARIABLE N IS DONE IN N        *
C*       STAGES. THE BACK SOLUTION FOR THE OTHER VARIABLES IS          *
C*       CALCULATED BY SUCCESSIVE SUBSTITUTIONS. FINAL SOLUTION        *
C*       VALUES ARE DEVELOPED IN COLUMN N+1 OF MATRIX A, WITH          *
C*       VARIABLE 1 IN A(1,N+1), VARIABLE 2 IN A(2,N+1),.....,         *
C*       VARIABLE N IN A(N,N+1).                                       *
C*                                                                     *
C***********************************************************************
      REAL A(LL,1),B,BIG
      N  = KK
      N1 = N+1
      DO 50  L=1,N
```

```
      L1 = L+1
      BIG = 0.0
      DO 25  I=L,N
      IF (ABS(A(I,L)).LE.ABS(BIG)) GO TO 25
      K = I
      BIG = A(I,L)
   25 CONTINUE
      IF (BIG.NE.0.0) GO TO 30
      WRITE(6,32000)
32000  FORMAT(24H SIMSOL MATRIX SINGULAR.)
      STOP
   30 DO 40  J=L,N1
      IF (K.EQ.L) GO TO 40
      B      = A(K,J)
      A(K,J) = A(L,J)
      A(L,J) = B
   40 A(L,J) = A(L,J)/BIG
      IF (L.EQ.N) GO TO 50
      DO 48  I=L1,N
      IF (A(I,L).EQ.0.0) GO TO 48
      DO 45  J=L1,N1
   45 A(I,J) = A(I,J)-A(I,L)*A(L,J)
   48 CONTINUE
   50 CONTINUE
      IF (N.EQ.1) RETURN
      N2 = N-1
      DO 60  L=1,N2
      I  = N-L
      L1 = I+1
      DO 60  J=L1,N
   60 A(I,N1) = A(I,N1)-A(I,J)*A(J,N1)
      RETURN
      END
```

```
      SUBROUTINE SUSFRC(DISP,VEL)
C             HVOSM-RD2 VERSION
C             REVISED OCTOBER 1975   CALSPAN CORPORATION
C
C   SUBROUTINE TO COMPUTE SUSPENSION FORCES ACTING BETWEEN SPRUNG
C   AND UNSPRUNG MASSES
C
      COMMON/INPT/PHIO,THETAO,PSIO,PO,QO,RO,XCOP,YCOP,ZCOP,UO,VO,WO,
     1            A,B,DEL10,DEL20,DEL30,PHIRO,DEL10D,DEL20D,DEL30D,
     2            PHIROD,TF,TR,ZF,ZR,RHO,AKRS,XMUR,
     3            XMS,XMUF,XIX,XIY,XIZ,XIXZ,CF,AKF,XLAMF,OMEGF,CFP,EPSF,
     4            RF,CR,AKR,XLAMR,OMEGR,CRP,EPSR,RR,TS,THMAX,DTCOMP,TO,
     5            T1,DTCMP1,DTPRNT,MODE,EBAR,EM,AAA,HMAX,HMIN,BET,G,
     6            HED(36),DADE(3),XIR,X1,Y1,Z1,X2,Y2,Z2,PHIC(50),DELB,
     7            DELE,DDEL,NDEL,PSIF(50),TQF(50),TQR(50),TB,TE,TINCR,
     8            NZTAB,NZ5,XBDRY(4,5),PSBDRY(4,5),YBDRY(2,5),NBX(5),
     9            NBY(5),NTBL1,NTBL2,NTBL3,ZGP(21,21,5)
      COMMON/INPT/XB(5),XE(5),XINCR(5),NX(5),YB(5),YE(5),YINCR(5),NY(5),
     1          XXZGP5(21),YYZGP5(21),AMUG(5),PSBDRO(4,5),UVWMIN,PQRMIN
      COMMON/INPT3/ AKFC,AKFCP,OMEGFC,AKFE,AKFEP,OMEGFE,AKRC,AKRCP,
     1              OMEGRC,AKRE,AKREP,OMEGRE,END3
      COMMON /INTG/NEQ,T,DT,VAR(50),DER(50)
      EQUIVALENCE (U,VAR(1)),(V,VAR(2)),(W,VAR(3)),(P,VAR(4)),(Q,VAR(5))
     1           ,(R,VAR(6)),(DEL1,VAR(7)),(DEL1D,VAR(8)),(DEL2,VAR(9)),
     2            (DEL2D,VAR(10)),(DEL3,VAR(11)),(DEL3D,VAR(12)),
     3            (PHIR,VAR(13)),(PHIRD,VAR(14)),(THETTP,VAR(15)),
     4            (PHITP,VAR(16)),(PSITP,VAR(17)),(XCP,VAR(18)),
     5            (YCP,VAR(19)),(ZCP,VAR(20)),(PSIFI,VAR(21)),
     6            (PSIFID,VAR(22))
      EQUIVALENCE (DU,DER(1)),(DV,DER(2)),(DW,DER(3)),(DP,DER(4)),
     1            (DQ,DER(5)),(DR,DER(6)),(DDEL1,DER(7)),(DDEL1D,DER(8))
     2           ,(DDEL2,DER(9)),(DDEL2D,DER(10)),(DDEL3,DER(11)),
     3            (DDEL3D,DER(12)),(DPHIR,DER(13)),(DPHIRD,DER(14)),
     4            (DTHTTP,DER(15)),(DPHITP,DER(16)),(DPSITP,DER(17)),
     5            (DXCP,DER(18)),(DYCP,DER(19)),(DZCP,DER(20)),
     6            (DPSIFI,DER(21)),(DDPSFI,DER(22))
      EQUIVALENCE (VAR(9),PHIF),(VAR(10),PHIFD),(DER(9),DPHIF),
     1            (DER(10),DPHIFD)
      EQUIVALENCE (VAR(13),DEL4),(VAR(14),DEL4D),(DER(13),DDEL4),
     1            (DER(14),DDEL4D)
      COMMON /DIMV/X1P,X2P,X3P,X4P,Y1P,Y2P,Y3P,Y4P,Z1P,Z2P,Z3P,Z4P,PHI1,
     1             PHI2,PHI3,PHI4,PSI1,PSI2,PSI3,PS14,CAYW(4),CBYW(4),
     2             CGYW(4),ZPGI(4),THGI(4),PHGI(4),CPG(4),SPG(4),CTG(4),
     3             STG(4),CAGZ(4),CBGZ(4),CGGZ(4),D1(4),D2(4),D3(4),
     4             XLM1(4),XLM2(4),XLM3(4),AMTX(3,3),CMTX(3,4),XGPP(4),
     5             YGPP(4),ZGPP(4),DMATX(10,11),DELTA(4),CAR(4),CBR(4),
     6             CGR(4),FR(4),HI(4),FC(4),TI(4),AX(4),BX(4),CX(4),
     7             CTXG(4),UG(4),STXG(4),AY(4),BY(4),CY(4),CPYG(4),
     8             SPYG(4),VG(4),PSIIP(4),PHICI(4),CAC(4),CBC(4),CGC(4),
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9            FCXU(4),FCYU(4),FCZU(4),FS(4),CAXW(4),CBXW(4),CGXW(4)SUSF0500
 COMMON /DIMV/AS(4),BS(4),CS(4),CAS(4),CBS(4),CGS(4),BETP(4),         SUSF0510
1            BETBR(4),FSXU(4),FSYU(4),FSZU(4),FRXU(4),FRYU(4),        SUSF0520
2            FRZU(4),FXU(4),FYU(4),FZU(4),SI(4),F1FI(2),F1RI(2),      SUSF0530
3            F2FI(2),F2RI(2),CAH(4),CBH(4),CGH(4)                     SUSF0540
 DIMENSION XP(4),YP(4),ZP(4),PHII(4),PSII(4)                          SUSF0550
 EQUIVALENCE (XP(1),X1P),(YP(1),Y1P),(ZP(1),Z1P),(PHII(1),PHI1),      SUSF0560
1           (PSII(1),PSI1)                                            SUSF0570
 COMMON /COMP/SUMM,THETN,PHIN,PSIN,PI,RAD,GAM1,GAM2,GAM3,GAM4,GAM5,SUSF0580
1           GAM6,GAM7,GAM8,GAM9,THETT,PHIT,PSIT,ZRO,TRO2,             SUSF0590
2            TFO2,TIZ,RHO2,RHOMUR,AMUF,BMUR,ZPR,TM4,RHMR2,AO2APB,     SUSF0600
3            BO2APB,RFTF,TSO2,RRTS,BROMUR,XMUFO2,AXMFO2,XMTFO4,       SUSF0610
4            XIZR,RTR,RHMR2I,XIXP,XIZP,XIXZP,XIYZP,D1PD2,D1MD2,       SUSF0620
5            ZRD3,ZRD3R,ZFD3R,ZFD12,TIZ2,TG61,DD1P2,DD1M2,RPR,PHRPSUSF0630
6           ,TANTP,SPHTP,CPHTP,SECTP,SFXS,SFYS,SFZS,SNPS,SNTS,        SUSF0640
7            SNPSS,TPR,CAY,CBY,CGY,CAX,CBX,CGX,SFYU,SFXU,SFYUF,       SUSF0650
8            SFYUR,SFZU,COSTH,SINTH,COSPS,SINPS,COSPH,SINPH,ANG1,     SUSF0660
9            ANG2,CPHI,SPHI,CPSI,SPSI,P1,P7,P3,P4,P5,P6,TX,TY,TZ      SUSF0670
 COMMON /COMP/TRH,DISTX,DISTY,DISTD,DISTS,D21,ZETA4,ZETA4D,ZETA3,     SUSF0680
1            ZETA3D,SFZ1,SNPU,SNTU,HCGH1,HCGH2,HCGH3,HCGH4,TERM1,     SUSF0690
2            TERM2,SNPSU,SNPR,HCBH1,HCBH2,HCBH3,HCBH4,HCAH1,HCAH2,SUSF0700
3            HCAH3,HCAH4,UQ,WP,UR,QR,VP,PR,P2,Q2,R2,VR,WQ,PQ,PHIR2SUSF0710
4           ,PHIRD2,RPHRD,GCTH,GSTH,GCTSP,GCTCP,XXX,YYY,IX,IY,XX1,SUSF0720
5            XX2,YY1,YY2,THG1,THG2,PHG1,PHG2,ZZ1,ZZ2,LLL              SUSF0730
 DIMENSION HCAH(4),HCBH(4),HCGH(4)                                    SUSF0740
 EQUIVALENCE (HCAH(1),HCAH1),(HCBH(1),HCBH1),(HCGH(1),HCGH1)          SUSF0750
 COMMON/ADTNL/ U1,U2,U3,U4,V1,V2,V3,V4,W1,W2,W3,W4,                   SUSF0760
1             XIYP,SPHIC,CPHIC,APTCH1,APTCH2,APTCH3,APTCH4,           SUSF0770
2             SLOPE1,SLOPE2,XTRA(300)                                 SUSF0780
 DIMENSION UI(4),VI(4),WI(4)                                          SUSF0790
 EQUIVALENCE (UI(1),U1),(VI(1),V1),(WI(1),W1)                         SUSF0800
 DIMENSION APITCH(4)                                                  SUSF0810
 EQUIVALENCE (APITCH(1),APTCH1)                                       SUSF0820
 COMMON/APTABL/ APFR(21,2),IAPFR(2),DAPFB,DAPFE,DDAPF,NAPF,           SUSF0830
1               DAPRB,DAPRE,DDAPR,NAPR                                SUSF0840
 DIMENSION APF(21),APR(21)                                            SUSF0850
 EQUIVALENCE (APFR(1,1),APF(1)),(APFR(1,2),APR(1))                    SUSF0860
 EQUIVALENCE (IAPF,IAPFR(1)),(IAPR,IAPFR(2))                          SUSF0870
 COMMON /INSUS/ XIF,RHOF,TSF,PHIFO,PHIFOD,DEL40,DEL40D,ISUS,          SUSF0880
1               AKDS,AKDS1,AKDS2,AKDS3,PHIRC(50),DTHF(50),DTHR(50),SUSF0890
2               NCAMF,NCAMR,NDTHF,NDTHR                               SUSF0900
 COMMON /SUSCMP/ XMURO2,BXMRO2,XMTRO4,ZFO,TSFO2,RHOF2,RHFMUF,          SUSF0910
1                RHF2MF,RF2MFI,RTF,RRTR,D3PD4,D3MD4,D43,DD3P4,        SUSF0920
2                DD3M4,ZFD1RF,ZRD34,RFPF,RPF2M,WFMF,PHFP,PHIF2,       SUSF0930
3                PHIFD2,RPHFD,ZFD1,ZFD2,ZRD4,TPF,SLOPE3,SLOPE4,       SUSF0940
4                PHI3D,PHI4D,DTHF1,DTHF2,DTHR3,DTHR4,DTDD1,           SUSF0950
5                DTDD2,DTDD3,DTDD4,FJF(4),SNPF                        SUSF0960
 DIMENSION DISP(4),VEL(4),F1I(4),F2I(4)                               SUSF0970
 EQUIVALENCE (F1I(1),F1FI(1)),(F2I(1),F2FI(1))                        SUSF0980
C                                                                     SUSF0990
 DO 500 I=1,4                                                         SUSF1000
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      IF(I.GE.3) GO TO 200
      IF(EPSF.LE.0.0) GO TO 10
      IF(ABS(VEL(I)).GE.EPSF) GO TO 10
      F1I(I) = (CFP/EPSF)*VEL(I)
      GO TO 20
   10 F1I(I) = SIGN(CFP,VEL(I))
   20 XLM = 1.0
      TMP = DISP(I)*VEL(I)
      IF(DISP(I).GT.OMEGFE) GO TO 30
      IF(DISP(I).LT.OMEGFC) GO TO 40
      F2I(I) = AKF*DISP(I)
      GO TO 100
   30 IF(TMP.LT.0.0) XLM = XLAMF
      DISP1 = DISP(I)-OMEGFE
      F2I(I) = AKF*DISP(I)+XLM*(AKFE*DISP1+AKFEP*DISP1**3)
      GO TO 100
   40 IF(TMP.LT.0.0) XLM = XLAMF
      DISP1 = DISP(I)-OMEGFC
      F2I(I) = AKF*DISP(I)+XLM*(AKFC*DISP1+AKFCP*DISP1**3)
      GO TO 100
  100 IF(IAPF.EQ.0) GO TO 150
      APITCH(I) = 0.0
      IF(FC(I).EQ.0.0) GO TO 150
      TMP3 = COS(PHII(I))*COS(PSII(I))/12.0
      CALL INTRPL(APF,DAPFB,DAPFE,DDAPF,DISP(I),APC)
      APITCH(I) = -APC*FC(I)*HI(I)*TMP3
  150 ABAR = RFTF*D21
      IF(ISUS.EQ.2) GO TO 105
      IF(I.EQ.2) GO TO 102
      FJF(1) = -SLOPE1*(FYU(1)*HCGH1-FZU(1)*HCBH1) + FYU(1)*DTDD1
      GO TO 103
  102 ABAR = -ABAR
      FJF(2) = -SLOPE2*(FYU(2)*HCGH2-FZU(2)*HCBH2) - FYU(2)*DTDD2
      GO TO 103
  105 ABAR =-RTF*PHIF
      IF(I.EQ.2) ABAR = -ABAR
      FJF(I) = 0.0
  103 S1(I) = BO2APB-CF*VEL(I)-F1I(I)-F2I(I)+ABAR+FJF(I)+APITCH(I)
      GO TO 500
  200 IF(EPSR.LE.0.0) GO TO 210
      IF(ABS(VEL(I)).GE.EPSR) GO TO 210
      F1I(I) = (CRP/EPSR)*VEL(I)
      GO TO 220
  210 F1I(I) = SIGN(CRP,VEL(I))
  220 XLM = 1.0
      TMP = DISP(I)*VEL(I)
      IF(DISP(I).GT.OMEGRE) GO TO 230
      IF(DISP(I).LT.OMEGRC) GO TO 240
      F2I(I) = AKR*DISP(I)
      GO TO 300
  230 IF(TMP.LT.0.0) XLM = XLAMR
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      DISP1 = DISP(I)-OMEGRE
      F2I(I) = AKR*DISP(I)+XLM*(AKRE*DISP1+AKREP*DISP1**3)
      GO TO 300
  240 IF(TMP.LT.0.0) XLM = XLAMR
      DISP1 = DISP(I)-OMEGRC
      F2I(I) = AKR*DISP(I)+XLM*(AKRC*DISP1+AKRCP*DISP1**3)
  300 IF(IAPR.EQ.0) GO TO 350
      APITCH(I) = 0.0
      IF(FC(I).EQ.0.0) GO TO 350
      TMP3 = COS(PHII(I))*COS(PSII(I))/12.0
      CALL INTRPL(APR,DAPRB,DAPRE,DDAPR,DISP(I),APC)
      APITCH(I) =  APC*FC(I)*HI(I)*TMP3
  350 ABAR = RRTR*D43
      IF(ISUS.NE.1) GO TO 305
      IF(I.EQ.4) GO TO 302
      FJF(3) = -SLOPE3*(FYU(3)*HCGH3-FZU(3)*HCBH3) + FYU(3)*DTDD3
      GO TO 303
  302 ABAR = - ABAR
      FJF(4) = -SLOPE4*(FYU(4)*HCGH4-FZU(4)*HCBH4) - FYU(4)*DTDD4
      GO TO 303
  305 ABAR = -RTR*PHIR
      IF(I.EQ.4) ABAR = -ABAR
      FJF(I) = 0.0
  303 SI(I) = A02APB-CR*VEL(I)-F1I(I)-F2I(I)+ABAR+APITCH(I)+FJF(I)
  500 CONTINUE
      SFZ1 = SI(1)+SI(2)+SI(3)+SI(4)
      RETURN
      END
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      SUBROUTINE TEREAD(I,NNBX,NNBY,NNX,NNY,NZ5T,NERR)                  TERE0010
C              HVOSM-RD2 VERSION                                         TERE0020
C              REVISED OCTOBER 1975   CALSPAN CORPORATION                TERE0030
      COMMON/INPT/PHIO,THETAO,PSIO,PO,QO,RO,XCOP,YCOP,ZCOP,UO,VO,WO,     TERE0040
     1            A,B,DEL1O,DEL2O,DEL3O,PHIRO,DEL1OD,DEL2OD,DEL3OD,      TERE0050
     2            PHIROD,TF,TR,ZF,ZR,RHO,AKRS,XMUR,                      TERE0060
     3            XMS,XMUF,XIX,XIY,XIZ,XIXZ,CF,AKF,XLAMF,OMEGF,CFP,EPSF,TERE0070
     4            RF,CR,AKR,XLAMR,OMEGR,CRP,EPSR,RR,TS,THMAX,DTCOMP,TO,  TERE0080
     5            T1,DTCMP1,DTPRNT,MODE,EBAR,EM,AAA,HMAX,HMIN,BET,G,     TERE0090
     6            HED(36),DADE(3),XIR,X1,Y1,Z1,X2,Y2,Z2,PHIC(50),DELB,   TERE0100
     7            DELE,DDEL,NDEL,PSIF(50),TQF(50),TQR(50),TB,TE,TINCR,   TERE0110
     8            NZTAB,NZ5,XBDRY(4,5),PSBDRY(4,5),YBDRY(2,5),NBX(5),    TERE0120
     9            NBY(5),NTBL1,NTBL2,NTBL3,ZGP(21,21,5)                  TERE0130
      COMMON/INPT/XB(5),XE(5),XINCR(5),NX(5),YB(5),YE(5),YINCR(5),NY(5),TERE0140
     1          XXZGP5(21),YYZGP5(21),AMUG(5),PSBDRO(4,5),UVWMIN,PQRMIN  TERE0150
      DIMENSION DUM(18)                                                  TERE0160
      LSEQ = 0                                                           TERE0170
      IF(NNBX.LE.0) GO TO 10                                             TERE0180
      READ(2,2000) (DUM(K),K=1,9),NSEQ,NCARD                             TERE0190
 2000 FORMAT(9F8.0,2I4)                                                  TERE0200
      IF(NSEQ.LT.LSEQ) GO TO 98                                          TERE0210
      LSEQ = NSEQ                                                        TERE0220
      IF(NNBX.GT.4) GOTO 98                                              TERE0230
      DO 11 K=1,NNBX                                                     TERE0240
   11 XBDRY(K,I) = DUM(K)                                                TERE0250
      READ(2,2000) (DUM(K),K=1,9),NSEQ,NCARD                             TERE0260
      IF(NSEQ.LT.LSEQ) GO TO 98                                          TERE0270
      LSEQ = NSEQ                                                        TERE0280
      DO 12 K=1,NNBX                                                     TERE0290
   12 PSBDRO(K,I) = DUM(K)                                               TERE0300
   10 IF(NNBY.LE.0) GO TO 20                                             TERE0310
      IF(NNBY.GT.2) GO TO 98                                             TERE0320
      READ(2,2000) (DUM(K),K=1,9),NSEQ,NCARD                             TERE0330
      IF(NSEQ.LT.LSEQ) GO TO 98                                          TERE0340
      LSEQ = NSEQ                                                        TERE0350
      DO 13 K=1,NNBY                                                     TERE0360
   13 YBDRY(K,I) = DUM(K)                                                TERE0370
   20 NYCDS = (NNY-1)/9+1                                                TERE0380
      DO 30 J=1,NNX                                                      TERE0390
      M = 0                                                              TERE0400
      DO 40 K=1,NYCDS                                                    TERE0410
      READ(2,2000) (DUM(N),N=1,9),NSEQ,NCARD                             TERE0420
      IF(NSEQ.LT.LSEQ) GO TO 98                                          TERE0430
      LSEQ = NSEQ                                                        TERE0440
      DO 50 N=1,9                                                        TERE0450
      M = M+1                                                            TERE0460
      ZGP(J,M,I) = DUM(N)                                                TERE0470
      IF(M.GE.NNY) GO TO 30                                              TERE0480
   50 CONTINUE                                                           TERE0490
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40 CONTINUE                                              TERE0500
30 CONTINUE                                              TERE0510
   IF(NZ5T.EQ.0) GO TO 99                                TERE0520
   M = 0                                                 TERE0530
   DO 60 K=1,NYCDS                                       TERE0540
   READ(2,2000) (DUM(N),N=1,9),NSEQ,NCARD                TERE0550
   IF(NSEQ.LT.LSEQ) GO TO 98                             TERE0560
   LSEQ = NSEQ                                           TERE0570
   DO 61 N=1,9                                           TERE0580
   M = M+1                                               TERE0590
   YYZGP5(M) = DUM(N)                                    TERE0600
   IF(M.GE.NNY) GO TO 70                                 TERE0610
61 CONTINUE                                              TERE0620
60 CONTINUE                                              TERE0630
70 NXCDS = (NNX-1)/9 + 1                                 TERE0640
   M = 0                                                 TERE0650
   DO 71 K=1,NXCDS                                       TERE0660
   READ(2,2000) (DUM(N),N=1,9),NSEQ,NCARD                TERE0670
   IF(NSEQ.LT.LSEQ) GO TO 98                             TERE0680
   LSEQ = NSEQ                                           TERE0690
   DO 72 N=1,9                                           TERE0700
   M = M+1                                               TERE0710
   XXZGP5(M) = DUM(N)                                    TERE0720
   IF(M.GE.NNX) GO TO 99                                 TERE0730
72 CONTINUE                                              TERE0740
71 CONTINUE                                              TERE0750
98 NERR = 1                                              TERE0760
99 RETURN                                                TERE0770
   END                                                   TERE0780
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      SUBROUTINE TIRFRC(J)                                              TIRF0010
C              HVOSM-RD2 VERSION                                        TIRF0020
C              REVISED OCTOBER 1975   CALSPAN CORPORATION               TIRF0030
      COMMON /DIMV/X1P,X2P,X3P,X4P,Y1P,Y2P,Y3P,Y4P,Z1P,Z2P,Z3P,Z4P,PHI1,TIRF0040
     1            PHI2,PHI3,PHI4,PSI1,PSI2,PSI3,PSI4,CAYW(4),CBYW(4),   TIRF0050
     2            CGYW(4),ZPGI(4),THGI(4),PHGI(4),CPG(4),SPG(4),CTG(4),TIRF0060
     3            STG(4),CAGZ(4),CBGZ(4),CGGZ(4),D1(4),D2(4),D3(4),     TIRF0070
     4            XLM1(4),XLM2(4),XLM3(4),AMTX(3,3),CMTX(3,4),XGPP(4),  TIRF0080
     5            YGPP(4),ZGPP(4),DMATX(10,11),DELTA(4),CAR(4),CBR(4),  TIRF0090
     6            CGR(4),FR(4),HI(4),FC(4),TI(4),AX(4),BX(4),CX(4),     TIRF0100
     7            CTXG(4),UG(4),STXG(4),AY(4),BY(4),CY(4),CPYG(4),      TIRF0110
     8            SPYG(4),VG(4),PSIIP(4),PHICI(4),CAC(4),CBC(4),CGC(4),TIRF0120
     9            FCXU(4),FCYU(4),FCZU(4),FS(4),CAXW(4),CBXW(4),CGXW(4)TIRF0130
      COMMON /DIMV/AS(4),BS(4),CS(4),CAS(4),CBS(4),CGS(4),BETP(4),      TIRF0140
     1            BETBR(4),FSXU(4),FSYU(4),FSZU(4),FRXU(4),FRYU(4),     TIRF0150
     2            FRZU(4),FXU(4),FYU(4),FZU(4),S1(4),F1FI(2),F1RI(2),   TIRF0160
     3            F2FI(2),F2RI(2),CAH(4),CBH(4),CGH(4)                  TIRF0170
      DIMENSION XP(4),YP(4),ZP(4),PHII(4),PSII(4)                       TIRF0180
      EQUIVALENCE (XP(1),X1P),(YP(1),Y1P),(ZP(1),Z1P),(PHII(1),PHI1),   TIRF0190
     1            (PSII(1),PSI1)                                        TIRF0200
      COMMON /COMP/SUMM,THETN,PHIN,PSIN,PI,RAD,GAM1,GAM2,GAM3,GAM4,GAM5,TIRF0210
     1           GAM6,GAM7,GAM8,GAM9,THETT,PHIT,PSIT,ZRO,TRO2,          TIRF0220
     2            TFO2,TIZ,RHO2,RHOMUR,AMUF,BMUR,ZPR,TM4,RHMR2,AO2APB,  TIRF0230
     3            BO2APB,RFTF,TSO2,RRTS,BROMUR,XMUFO2,AXMFO2,XMTFO4,    TIRF0240
     4            XIZR,RTR,RHMR2I,XIXP,XIZP,XIXZP,XIYZP,D1PD2,D1MD2,    TIRF0250
     5            ZRD3,ZRD3R,ZFD3R,ZFD12,TIZ2,TG61,DD1P2,DD1M2,RPR,PHRPTIRF0260
     6           ,TANTP,SPHTP,CPHTP,SECTP,SFXS,SFYS,SFZS,SNPS,SNTS,     TIRF0270
     7            SNPSS,TPR,CAY,CBY,CGY,CAX,CBX,CGX,SFYU,SFXU,SFYUF,    TIRF0280
     8            SFYUR,SFZU,COSTH,SINTH,COSPS,SINPS,COSPH,SINPH,ANG1,  TIRF0290
     9            ANG2,CPHI,SPHI,CPSI,SPSI,P1,P7,P3,P4,P5,P6,TX,TY,TZ   TIRF0300
      COMMON /COMP/TRH,DISTX,DISTY,DISTD,DISTS,D21,ZETA4,ZETA4D,ZETA3,  TIRF0310
     1            ZETA3D,SFZ1,SNPU,SNTU,HCGH1,HCGH2,HCGH3,HCGH4,TERM1,  TIRF0320
     2            TERM2,SNPSU,SNPR,HCBH1,HCBH2,HCBH3,HCBH4,HCAH1,HCAH2,TIRF0330
     3            HCAH3,HCAH4,UQ,WP,UR,QR,VP,PR,P2,Q2,R2,VR,WQ,PQ,PHIR2TIRF0340
     4           ,PHIRD2,RPHRD,GCTH,GSTH,GCTSP,GCTCP,XXX,YYY,IX,IY,XX1,TIRF0350
     5            XX2,YY1,YY2,THG1,THG2,PHG1,PHG2,ZZ1,ZZ2,LLL           TIRF0360
      DIMENSION HCAH(4),HCBH(4),HCGH(4)                                 TIRF0370
      EQUIVALENCE (HCAH(1),HCAH1),(HCBH(1),HCBH1),(HCGH(1),HCGH1)       TIRF0380
      COMMON /COMPN/ FRSP(4),FRCP(4),ICBHIT,JCBHIT,                     TIRF0390
     1              DPSINT,TANPC1,TANPC2,PHIC1R,PHIC2R,AMUCMP,PHI1D,    TIRF0400
     2              PHI2D,LCB1(4),LCB2(4),IHIT,AJMTX(3,3),BMTX(3,3),    TIRF0410
     3              SFRX(4),SFRY(4),SFRZ(4),T1PSI,T2PSI,XMUGI(4)        TIRF0420
      LOGICAL LCB1,LCB2                                                 TIRF0430
      COMMON/ADTNL/ U1,U2,U3,U4,V1,V2,V3,V4,W1,W2,W3,W4,                TIRF0440
     1             XIYP,SPHIC,CPHIC,APTCH1,APTCH2,APTCH3,APTCH4,        TIRF0450
     2             SLOPE1,SLOPE2,XTRA(300)                              TIRF0460
      DIMENSION UI(4),VI(4),WI(4)                                       TIRF0470
      EQUIVALENCE (UI(1),U1),(VI(1),V1),(WI(1),W1)                      TIRF0480
      DIMENSION APITCH(4)                                               TIRF0490
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      EQUIVALENCE (APITCH(1),APTCH1)
      COMMON /TIRIN/ AKT(4),SIGT(4),XLAMT(4),A0(4),A1(4),A2(4),A3(4),
     1               A4(4),OMEGT(4),AMU(4),RW(4),FJP(35,4),A234(4),
     2               A12(4),OMT2A2(4),OMT2M1(4),A23(4),ITIR(4)
    1 ITER = 0
      I = J
      K = J
      SPHIC = CAYW(I)*CAGZ(I)+CBYW(I)*CBGZ(I)+CGYW(I)*CGGZ(I)
      PHICI(I) = ARSIN(SPHIC)
      CPHIC = COS(PHICI(I))
      IF(FR(I).NE.0.0) GO TO 2
  100 FC(I) = 0.0
      FS(I) = 0.0
      FRCP(I) = 0.0
      FCXU(I) = 0.0
      FCYU(I) = 0.0
      FCZU(I) = 0.0
      FRXU(I) = 0.0
      FRYU(I) = 0.0
      FRZU(I) = 0.0
      FSXU(I) = 0.0
      FSYU(I) = 0.0
      FSZU(I) = 0.0
      FXU(I) = 0.0
      FYU(I) = 0.0
      FZU(I) = 0.0
C      NOTE THAT SFXU, SFYU, AND SFZU ARE UNCHANGED
      RETURN
    2 I = J
      K = J
      FRTEST = (FR(I) - FS(I)*SPHIC)
      IF(FRTEST.LE.0.0)GO TO 100
      FRCP(I) = FRTEST/CPHIC
      FC(I) = 0.0
      TERM = 0.0
      PSITEM = PSIIP(I) * SIGN(1.0,UG(I))
      IF(UG(I).NE.0.0.OR.VG(I).NE.0.0)TERM = ATAN2(VG(I),ABS(UG(I)))
      IF(TI(I))3,6,4
    3 FCTR = - COS(TERM - PSITEM    )
      FACTOR = XMUGI(I)*FRCP(I) * FCTR
      IF( ABS(TI(I)) - ABS(FACTOR) ) 31,31,32
   31 FC(I) = TI(I) * SIGN(1.0,UG(I))
      GO TO 33
   32 FC(I) = FACTOR* SIGN(1.0,UG(I))
   33 IF( ABS(UG(I)) . LT.  (1.932))  FC(I) = FC(I)*ABS(UG(I))/1.932
      GO TO 6
    4 FC(I) = XMUGI(I) * FRCP(I)
      IF(ABS(TI(I)).LT.ABS(FC(I))) FC(I) = TI(I)
    6 IF(I.EQ.1.OR.I.EQ.3)GO TO 64
      IF(TI(I).LE.0.0)GO TO 64
      I = I-1
```

```
   60 DO 61 L=I,J                                                    TIRF1010
      IF( ABS(XMUGI(L)*FRCP(L)) .LT. TI(L)) GO TO 62                TIRF1020
   61 CONTINUE                                                       TIRF1030
      GO TO 64                                                       TIRF1040
   62 IF(FC(I)*HI(I).GT.FC(J)*HI(J))GO TO 63                         TIRF1050
      FC(J) = FC(I)*HI(I)/HI(J)                                      TIRF1060
      GO TO 64                                                       TIRF1070
   63 K = I                                                          TIRF1080
      FC(I) = FC(J)*HI(J)/HI(I)                                      TIRF1090
   64 DO 14 I=K,J                                                    TIRF1100
      FS(I) = 0.0                                                    TIRF1110
      PSITEM = PSIIP(I) * SIGN(1.0,UG(I))                            TIRF1120
      IF( ABS(FC(I)).LT. ABS(XMUGI(I)*FRCP(I))-1.0) GO TO 65        TIRF1130
      BETBR(I) = 3.1                                                 TIRF1140
      GO TO 12                                                       TIRF1150
C           BETBR(I) SET TO INDICATE SKID  ON OUTPUT.                TIRF1160
   65 IF( ABS(UG(I)) .GT. 0.5) GO TO 7                               TIRF1170
      IF( ABS(VG(I)) .LE. 0.5) GO TO 12                              TIRF1180
    7 FS(I) = SQRT((XMUGI(I)*FRCP(I))**2 - FC(I)**2)                 TIRF1190
      IF(FRCP(I).GT.OMEGT(I)*A2(I)) GO TO 8                          TIRF1200
      BETP(I) = (PHICI(I)-.6366*PHICI(I)*ABS(PHICI(I)))*A234(I)*FRCP(I) TIRF1210
     1          *(A4(I)-FRCP(I)) / (A1(I)*FRCP(I)*(FRCP(I)-A2(I))    TIRF1220
     2          -A0(I)*A2(I))                                        TIRF1230
      BETBR(I) = (TERM+BETP(I)-PSITEM)*(A12(I)*FRCP(I)*              TIRF1240
     1           (FRCP(I)-A2(I))-A0(I)) / FS(I)                      TIRF1250
      GO TO 9                                                        TIRF1260
    8 BETP(I) = (PHICI(I)-.6366*PHICI(I)*ABS(PHICI(I)))*OMT2A2(I)    TIRF1270
      BETBR(I) = (TERM+BETP(I)-PSITEM)*(OMT2M1(I)-A0(I)) / FS(I)     TIRF1280
    9 IF(ABS(BETBR(I)).LT.3.0) GO TO 10                              TIRF1290
      FS(I) = SIGN(FS(I),BETBR(I))                                   TIRF1300
      GO TO 11                                                       TIRF1310
   10 FS(I) = FS(I)*(BETBR(I)-BETBR(I)*ABS(BETBR(I))/3.+BETBR(I)**3/27.)TIRF1320
   11 ITER = ITER+1                                                  TIRF1330
      GO TO (2,12),ITER                                              TIRF1340
   12 FSXU(I) =  FS(I)*(AMTX(1,1)*CAS(I)+AMTX(2,1)*CBS(I)+AMTX(3,1)*  TIRF1350
     1          CGS(I))                                              TIRF1360
      FSYU(I) =  FS(I)*(AMTX(1,2)*CAS(I)+AMTX(2,2)*CBS(I)+AMTX(3,2)*  TIRF1370
     1          CGS(I))                                              TIRF1380
      FSZU(I) =  FS(I)*(AMTX(1,3)*CAS(I)+AMTX(2,3)*CBS(I)+AMTX(3,3)*  TIRF1390
     1          CGS(I))                                              TIRF1400
      FRXU(I) = -FRCP(I)*(AMTX(1,1)*CAGZ(I)+AMTX(2,1)*CBGZ(I)+AMTX(3,1)*TIRF1410
     1          CGGZ(I))                                             TIRF1420
      FRYU(I) = -FRCP(I)*(AMTX(1,2)*CAGZ(I)+AMTX(2,2)*CBGZ(I)+AMTX(3,2)*TIRF1430
     1          CGGZ(I))                                             TIRF1440
      FRZU(I) = -FRCP(I)*(AMTX(1,3)*CAGZ(I)+AMTX(2,3)*CBGZ(I)+AMTX(3,3)*TIRF1450
     1          CGGZ(I))                                             TIRF1460
      FCXU(I) = FC(I)*(AMTX(1,1)*CAC(I)+AMTX(2,1)*CBC(I)+AMTX(3,1)*   TIRF1470
     1          CGC(I))                                              TIRF1480
      FCYU(I) = FC(I)*(AMTX(1,2)*CAC(I)+AMTX(2,2)*CBC(I)+AMTX(3,2)*   TIRF1490
     1          CGC(I))                                              TIRF1500
      FCZU(I) = FC(I)*(AMTX(1,3)*CAC(I)+AMTX(2,3)*CBC(I)+AMTX(3,3)*   TIRF1510
```

```
 1           CGC(I))
13 FXU(I) = FRXU(I)+FCXU(I)+FSXU(I)
   SFXU = SFXU+FXU(I)
   FYU(I) = FRYU(I)+FCYU(I)+FSYU(I)
   SFYU = SFYU+FYU(I)
   FZU(I) = FRZU(I)+FCZU(I)+FSZU(I)
   SFZU = SFZU+FZU(I)
14 CONTINUE
   RETURN
   END
```

```
      SUBROUTINE TMCNST
C              HVOSM-RD2 VERSION
C              REVISED OCTOBER 1975   CALSPAN CORPORATION
      COMMON/INPT/PHIO,THETAO,PSIO,PO,QO,RO,XCOP,YCOP,ZCOP,UO,VO,WO,
     1           A,B,DEL10,DEL20,DEL30,PHIRO,DEL10D,DEL20D,DEL30D,
     2           PHIROD,TF,TR,ZF,ZR,RHO,AKRS,XMUR,
     3           XMS,XMUF,XIX,XIY,XIZ,XIXZ,CF,AKF,XLAMF,OMEGF,CFP,EPSF,
     4           RF,CR,AKR,XLAMR,OMEGR,CRP,EPSR,RR,TS,THMAX,DTCOMP,TO,
     5           T1,DTCMP1,DTPRNT,MODE,EBAR,EM,AAA,HMAX,HMIN,BET,G,
     6           HED(36),DADE(3),XIR,X1,Y1,Z1,X2,Y2,Z2,PHIC(50),DELB,
     7           DELE,DDEL,NDEL,PSIF(50),TQF(50),TQR(50),TB,TE,TINCR,
     8           NZTAB,NZ5,XBDRY(4,5),PSBDRY(4,5),YBDRY(2,5),NBX(5),
     9           NBY(5),NTBL1,NTBL2,NTBL3,ZGP(21,21,5)
      COMMON/INPT/XB(5),XE(5),XINCR(5),NX(5),YB(5),YE(5),YINCR(5),NY(5),
     1         XXZGP5(21),YYZGP5(21),AMUG(5),PSBDRO(4,5),UVWMIN,PQRMIN
      COMMON /INTG/NEQ,T,DT,VAR(50),DER(50)
      EQUIVALENCE (U,VAR(1)),(V,VAR(2)),(W,VAR(3)),(P,VAR(4)),(Q,VAR(5))
     1          ,(R,VAR(6)),(DEL1,VAR(7)),(DEL1D,VAR(8)),(DEL2,VAR(9)),
     2           (DEL2D,VAR(10)),(DEL3,VAR(11)),(DEL3D,VAR(12)),
     3           (PHIR,VAR(13)),(PHIRD,VAR(14)),(THETTP,VAR(15)),
     4           (PHITP,VAR(16)),(PSITP,VAR(17)),(XCP,VAR(18)),
     5           (YCP,VAR(19)),(ZCP,VAR(20)),(PSIFI,VAR(21)),
     6           (PSIFID,VAR(22))
      EQUIVALENCE (DU,DER(1)),(DV,DER(2)),(DW,DER(3)),(DP,DER(4)),
     1           (DQ,DER(5)),(DR,DER(6)),(DDEL1,DER(7)),(DDEL1D,DER(8))
     2          ,(DDEL2,DER(9)),(DDEL2D,DER(10)),(DDEL3,DER(11)),
     3           (DDEL3D,DER(12)),(DPHIR,DER(13)),(DPHIRD,DER(14)),
     4           (DTHTTP,DER(15)),(DPHITP,DER(16)),(DPSITP,DER(17)),
     5           (DXCP,DER(18)),(DYCP,DER(19)),(DZCP,DER(20)),
     6           (DPSIFI,DER(21)),(DDPSFI,DER(22))
      EQUIVALENCE (VAR(9),PHIF),(VAR(10),PHIFD),(DER(9),DPHIF),
     1           (DER(10),DPHIFD)
      EQUIVALENCE (VAR(13),DEL4),(VAR(14),DEL4D),(DER(13),DDEL4),
     1           (DER(14),DDEL4D)
      COMMON /COMP/SUMM,THETN,PHIN,PSIN,PI,RAD,GAM1,GAM2,GAM3,GAM4,GAM5,
     1           GAM6,GAM7,GAM8,GAM9,THETT,PHIT,PSIT,ZRO,TRO2,
     2            TFO2,TIZ,RHO2,RHOMUR,AMUF,BMUR,ZPR,TM4,RHMR2,AO2APB,
     3            BO2APB,RFTF,TSO2,RRTS,BROMUR,XMUFO2,AXMFO2,XMTFO4,
     4            XIZR,RTR,RHMR2I,XIXP,XIZP,XIXZP,XIYZP,D1PD2,D1MD2,
     5            ZRD3,ZRD3R,ZFD3R,ZFD12,TIZ2,TG61,DD1P2,DD1M2,RPR,PHRP
     6           ,TANTP,SPHTP,CPHTP,SECTP,SFXS,SFYS,SFZS,SNPS,SNTS,
     7            SNPSS,TPR,CAY,CBY,CGY,CAX,CBX,CGX,SFYU,SFXU,SFYUF,
     8            SFYUR,SFZU,COSTH,SINTH,COSPS,SINPS,COSPH,SINPH,ANG1,
     9            ANG2,CPHI,SPHI,CPSI,SPSI,P1,P7,P3,P4,P5,P6,TX,TY,TZ
      COMMON /COMP/TRH,DISTX,DISTY,DISTD,DISTS,D21,ZETA4,ZETA4D,ZETA3,
     1            ZETA3D,SFZ1,SNPU,SNTU,HCGH1,HCGH2,HCGH3,HCGH4,TERM1,
     2            TERM2,SNPSU,SNPR,HCBH1,HCBH2,HCBH3,HCBH4,HCAH1,HCAH2,
     3            HCAH3,HCAH4,UQ,WP,UR,QR,VP,PR,P2,Q2,R2,VR,WQ,PQ,PHIR2
     4           ,PHIRD2,RPHRD,GCTH,GSTH,GCTSP,GCTCP,XXX,YYY,IX,IY,XX1,
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     5             XX2,YY1,YY2,THG1,THG2,PHG1,PHG2,ZZ1,ZZ2,LLL                 TMCN0500
      DIMENSION HCAH(4),HCBH(4),HCGH(4)                                         TMCN0510
      EQUIVALENCE (HCAH(1),HCAH1),(HCBH(1),HCBH1),(HCGH(1),HCGH1)               TMCN0520
C      COMMON/EINDEX/ FOR EULER ANGLE INDEXING,MAIN,CNSTNT,DAUX,TMCNST          TMCN0530
      COMMON/EINDEX/ TWOPI,PIO2,PIO4,XINDN,XINDL,THETTL,PHITL,PSITL,            TMCN0540
     1               COSTHN,SINTHN,COSPSN,SINPSN,COSPHN,SINPHN,CTHETP,          TMCN0550
     2               STHETP,CPSTP,SPSTP,BNMTX(3,3), CNMTX(3,3),ENDEIN           TMCN0560
      COMMON /INSUS/ XIF,RHOF,TSF,PHIFO,PHIFOD,DEL40,DEL40D,ISUS,               TMCN0570
     1               AKDS,AKDS1,AKDS2,AKDS3,PHIRC(50),DTHF(50),DTHR(50),TMCN0580
     2               NCAMF,NCAMR,NDTHF,NDTHR                                    TMCN0590
      COMMON /SUSCMP/ XMURO2,BXMRO2,XMTRO4,ZFO,TSFO2,RHOF2,RHFMUF,              TMCN0600
     1                RHF2MF,RF2MFI,RTF,RRTR,D3PD4,D3MD4,D43,DD3P4,             TMCN0610
     2                DD3M4,ZFD1RF,ZRD34,RFPF,RPF2M,WFMF,PHFP,PHIF2,            TMCN0620
     3                PHIFO2,RPHFO,ZFD1,ZFD2,ZRD4,TPF,SLOPE3,SLOPE4,            TMCN0630
     4                PHI3D,PHI4D,DTHF1,DTHF2,DTHR3,DTHR4,DTDD1,                TMCN0640
     5                DTDD2,DTDD3,DTDD4,FJF(4),SNPF                             TMCN0650
      DIMENSION ANAME(3)                                                        TMCN0660
      DATA ANAME(1)/4HPSIT/,ANAME(2)/4HTHET/,ANAME(3)/4HPHIT/                   TMCN0670
      COMMON/NSTOP/ISTOP                                                        TMCN0680
C       * * * * FOR TEMPORARY ERROR STOP, USE THE VARIABLE ASTOP AS SHOWTMCN0690
C     ASTOP IS SOME LARGE NUMBER TO BE COMPARED TO THE ANGLES IN RADIANSTMCN0700
      DATA ASTOP/3000./                                                         TMCN0710
      IF(PHITP.GE.ASTOP .OR. THETTP.GE.ASTOP) GO TO 60                          TMCN0720
C         * * * * ** * * *                                                      TMCN0730
C          THETTL,PHITL,PSITL ARE VALUES OF THETT,PHIT,PSIT FROM PREVIOUTMCN0740
C           TIME INTERVAL, USED TO TEST NEW ANGLES     IN SUBROUTINE TMCTMCN0750
C      XINDL IS PREVIOUS VALUE OF XINDN. XINDL INITIALLY ZERO GETS BNMTXTMCN0760
C             XINDN.NE.0.0 FOR THETAO OR PHIO .NE.0.0, OR AFTER INDEXING TMCN0770
C             THAT IS  THETN OR PHIN NOW .NE. 0.0                       TMCN0780
C             USED IN MAIN PROGRAM AND IN SUBROUTINES CNSTNT,TMCNST     TMCN0790
      UQ = U*Q                                                                  TMCN0800
      WP = W*P                                                                  TMCN0810
      UR = U*R                                                                  TMCN0820
      QR = Q*R                                                                  TMCN0830
      VP = V*P                                                                  TMCN0840
      PR = P*R                                                                  TMCN0850
      P2 = P*P                                                                  TMCN0860
      Q2 = Q*Q                                                                  TMCN0870
      R2 = R*R                                                                  TMCN0880
      VR = V*R                                                                  TMCN0890
      WQ = W*Q                                                                  TMCN0900
      PQ = P*Q                                                                  TMCN0910
      ZFD1 = ZF+DEL1                                                            TMCN0920
      ZRD3 = ZR+DEL3                                                            TMCN0930
      IF(ISUS.NE.1) GO TO 100                                                   TMCN0940
      D3PD4 = DEL3+DEL4                                                         TMCN0950
      D3MD4 = DEL3-DEL4                                                         TMCN0960
      D43 = -D3MD4                                                              TMCN0970
      DD3P4 = DEL3D+DEL4D                                                       TMCN0980
      DD3M4 = DEL3D-DEL4D                                                       TMCN0990
      ZRD34 = ZR+0.5*D3PD4                                                      TMCN1000
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      ZRD4 = ZR+DEL4                                                    TMCN1010
      GO TO 200                                                         TMCN1020
  100 IF(ISUS.NE.2) GO TO 200                                           TMCN1030
      PHIF2 = PHIF*PHIF                                                 TMCN1040
      PHIFD2 = PHIFD*PHIFD                                              TMCN1050
      ZFD1RF = ZFD1+RHOF                                                TMCN1060
      RPF2M = RHF2MF*PHIF2                                              TMCN1070
      RFPF = RHOF*PHIF                                                  TMCN1080
      WFMF = XMUF*(DEL1D-RFPF*PHIFD)                                    TMCN1090
      PHFP = PHIF-PHITP                                                 TMCN1100
      RPHFD = R*PHIFD                                                   TMCN1110
      TPF = 0.5*TF*PHIF                                                 TMCN1120
      GO TO 300                                                         TMCN1130
  200 IF(ISUS.EQ.2) GO TO 300                                           TMCN1140
      ZFD2 = ZF+DEL2                                                    TMCN1150
      D1PD2 = DEL1+DEL2                                                 TMCN1160
      D1MD2 = DEL1-DEL2                                                 TMCN1170
      DD1P2 = DEL1D+DEL2D                                               TMCN1180
      DD1M2 = DEL1D-DEL2D                                               TMCN1190
      D21 = -D1MD2                                                      TMCN1200
      ZFD12 = ZF+0.5*D1PD2                                              TMCN1210
  300  IF(ISUS.EQ.1) GO TO 400                                          TMCN1220
      PHIR2 = PHIR*PHIR                                                 TMCN1230
      PHIRD2 = PHIRD*PHIRD                                              TMCN1240
      ZRD3R = ZRD3+RHO                                                  TMCN1250
      ZFD3R = ZF+DEL3+RHO                                               TMCN1260
      RPR = RHO*PHIR                                                    TMCN1270
      TIZ2 = RHMR2*PHIR2                                                TMCN1280
      TG61 = XMUR*(DEL3D-RPR*PHIRD)                                     TMCN1290
      PHRP = PHIR-PHITP                                                 TMCN1300
      TPR = 0.5*TR*PHIR                                                 TMCN1310
      RPHRD = R*PHIRD                                                   TMCN1320
  400 CONTINUE                                                          TMCN1330
    2 SPHTP = SIN(PHITP)                                                TMCN1340
      CPHTP = COS(PHITP)                                                TMCN1350
      TANTP = TAN(THETTP)                                               TMCN1360
      CTHETP = COS(THETTP)                                              TMCN1370
      SECTP = 1.0/CTHETP                                                TMCN1380
      IF(XINDN)    7, 5, 7                                              TMCN1390
    5 THETT  = THETTP                                                   TMCN1400
      PHIT   = PHITP                                                    TMCN1410
      PSIT   = PSITP + PSIN                                             TMCN1420
      SINPS = SIN(PSIT)                                                 TMCN1430
      COSPS = COS(PSIT)                                                 TMCN1440
      GO TO 70                                                          TMCN1450
    7 IF(XINDN - XINDL)  9,11,9                                         TMCN1460
C          COMPUTE BNMTX  ONCE AFTER EACH INDEXING ON THETMX            TMCN1470
    9 XINDL = XINDN                                                     TMCN1480
C          IF THETAO OR PHIO .NE.0.0 COMPUTE BNMTX  ONCE AT T=TO        TMCN1490
      COSTHN = COS(THETN)                                               TMCN1500
      SINTHN = SIN(THETN)                                               TMCN1510
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```
      COSPHN = COS(PHIN)
      SINPHN = SIN(PHIN)
      COSPSN = COS(PSIN)
      SINPSN = SIN(PSIN)
      BNMTX (1,1)= COSTHN *COSPSN
      BNMTX (2,1) = COSTHN*SINPSN
      BNMTX (3,1) = -SINTHN
      BNMTX (1,2) = -COSPHN*SINPSN + SINPHN*SINTHN*COSPSN
      BNMTX (2,2) =  COSPHN*COSPSN + SINPHN*SINTHN*SINPSN
      BNMTX (3,2) =  COSTHN*SINPHN
      BNMTX (1,3) =  SINPHN*SINPSN + COSPHN*SINTHN*COSPSN
      BNMTX (2,3) = -COSPSN*SINPHN + COSPHN*SINTHN*SINPSN
      BNMTX (3,3) =  COSTHN*COSPHN
   11 STHETP = SIN(THETTP)
      SPSTP  = SIN(PSITP)
      CPSTP  = COS(PSITP)
      CNMTX (1,1) = CTHETP*CPSTP
      CNMTX (2,1) = CTHETP*SPSTP
      CNMTX (3,1) = -STHETP
      TMP1   =   SPHTP * STHETP
      TMP2   =   CPHTP * STHETP
      CNMTX (1,2) =  -CPHTP*SPSTP  + TMP1*CPSTP
      CNMTX (2,2) =    CPHTP*CPSTP  + TMP1*SPSTP
      CNMTX (3,2) =    CTHETP*SPHTP
      CNMTX (1,3) =  SPHTP*SPSTP   + TMP2*CPSTP
      CNMTX (2,3) = -CPSTP*SPHTP   + TMP2*SPSTP
      CNMTX (3,3) =  CTHETP*CPHTP
C         COMPUTE CNMTX EACH R-K STEP IF XINDN.NE.0.0
C     ITRY, INDICATOR TO ALLOW ONE ADDITIONAL REVOLUTION FOR TRIAL ANGLE
      ITRY = 0
C         IANG = 1  FOR PSIT, =2 FOR THETT,  =3 FOR PHIT  DETERMINATION
      IANG = 1
      ANGL = PSITL
      TMP3 =   BNMTX(2,1)*CNMTX(1,1) + BNMTX(2,2)*CNMTX(2,1)  +
     X         BNMTX(2,3)*CNMTX(3,1)
      TMP4 =           BNMTX(1,1)*CNMTX(1,1) + BNMTX(1,2)*CNMTX(2,1) +
     X                 BNMTX(1,3)*CNMTX(3,1)
C     NOTE, TANA AND ANGA=ATAN(TANA) NOT USED WHEN DENOMINATOR TANA ZERO
      IF(TMP4)  18,14,18
   14 IF(TMP3) 15,16,17
   15 ANGA = - PIO2
      GO TO 21
   16 ISTOP = 4
      GO TO 64
C
   17 ANGA =   PIO2
      GO TO 21
   18 TANA = TMP3/TMP4
C
   20 ANGA = ATAN(TANA)
   21 NREV = ANGL/TWOPI  + SIGN(0.1 ,ANGL)
```

```
      FNREV = FLOAT(NREV)  * TWOPI                                      TMCN2030
   22 ANGTRY =  ANGA + FNREV                                            TMCN2040
      DIFFA  =  ANGTRY                                                  TMCN2050
      DIFFL =  DIFFA - ANGL                                             TMCN2060
      IF(ABS(DIFFL) - PI04) 40,40,25                                    TMCN2070
   25 DIFFA = ANGTRY + PI                                               TMCN2080
      DIFFL = DIFFA - ANGL                                              TMCN2090
      IF(ABS(DIFFL) - PI04) 40,40,27                                    TMCN2100
   27 DIFFA = ANGTRY - PI                                               TMCN2110
      DIFFL = DIFFA - ANGL                                              TMCN2120
      IF(ABS(DIFFL) - PI04) 40,40,29                                    TMCN2130
   29 IF(ANGTRY) 30,30,31                                               TMCN2140
   30 TWOPIA = TWOPI                                                    TMCN2150
      GO TO 32                                                          TMCN2160
   31 TWOPIA = - TWOPI                                                  TMCN2170
   32 DIFFA  =  ANGTRY + TWOPIA                                         TMCN2180
      DIFFL = DIFFA - ANGL                                              TMCN2190
      IF(ABS(DIFFL) - PI04) 40,40,33                                    TMCN2200
   33 IF (ITRY) 36,34,36                                                TMCN2210
   34 FNREV = FNREV + SIGN(TWOPI,ANGL)                                  TMCN2220
      ITRY = 1                                                          TMCN2230
C        ONCE ONLY, INCREASE FNREV BY ONE REVOLUTION AND TRY AGAIN      TMCN2240
      GO TO 22                                                          TMCN2250
   36 ISTOP = 5                                                         TMCN2260
      WRITE(6,1005) T,ANAME(IANG),ANGL, DIFFA ,ANGA,ANGTRY              TMCN2270
 1005 FORMAT( 7HO TIME=,F8.3,5X,A4,11H  PREVIOUS=,1PE13.5,6H, NEW=,E13.5TMCN2280
     X,12H, AS ARCTAN=, E13.5, 16H,  CORR.FOR REV=,E13.5 ,8H   STOP5)   TMCN2290
      GO TO 64                                                          TMCN2300
C                                                                       TMCN2310
   40 ITRY = 0                                                          TMCN2320
      IF(IANG-2) 41,50,59                                               TMCN2330
   41 IANG = 2                                                          TMCN2340
      PSIT = DIFFA                                                      TMCN2350
      SINPS  = SIN(PSIT)                                                TMCN2360
      COSPS = COS(PSIT)                                                 TMCN2370
      ANGL = THETTL                                                     TMCN2380
      TMP5  =       -(BNMTX(3,1)*CNMTX(1,1) + BNMTX(3,2)*CNMTX(2,1) +   TMCN2390
     X               BNMTX(3,3)*CNMTX(3,1) )                            TMCN2400
      IF( ABS(SINPS) - 0.7) 42,42,43                                    TMCN2410
   42 TMPP4 = TMP4/COSPS                                                TMCN2420
      IF (TMPP4) 49,44,49                                               TMCN2430
   43 TMPP4 = TMP3/SINPS                                                TMCN2440
      IF (TMPP4) 49,44,49                                               TMCN2450
   44 IF( TMP5) 45,46,47                                                TMCN2460
   45 ANGA = - PIO2                                                     TMCN2470
      GO TO 21                                                          TMCN2480
   46 ISTOP = 6                                                         TMCN2490
      GO TO 64                                                          TMCN2500
   47 ANGA = PIO2                                                       TMCN2510
      GO TO 21                                                          TMCN2520
   49 TANA = TMP5/TMPP4                                                 TMCN2530
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```
      GO TO 20                                                          TMCN2540
   50 IANG = 3                                                          TMCN2550
      THETT  = DIFFA                                                    TMCN2560
      ANGL   = PHITL                                                    TMCN2570
      TMP6   =  BNMTX(3,1)*CNMTX(1,2) +  BNMTX(3,2)*CNMTX(2,2)  +       TMCN2580
     X          BNMTX(3,3)*CNMTX(3,2)                                   TMCN2590
      TMP7   =  BNMTX(3,1)*CNMTX(1,3) +  BNMTX(3,2)*CNMTX(2,3)  +       TMCN2600
     X          BNMTX(3,3)*CNMTX(3,3)                                   TMCN2610
      IF(TMP7)  55,51,55                                                TMCN2620
   51 IF(TMP6)  52,53,54                                                TMCN2630
   52 ANGA = - PIO2                                                     TMCN2640
      GO TO 21                                                          TMCN2650
   53 ISTOP = 7                                                         TMCN2660
      GO TO 64                                                          TMCN2670
   54 ANGA =   PIO2                                                     TMCN2680
      GO TO 21                                                          TMCN2690
   55 TANA =  TMP6/TMP7                                                 TMCN2700
      GO TO 20                                                          TMCN2710
   59 PHIT = DIFFA                                                      TMCN2720
C       AT ST 70 HAVE NEW PSIT,THETT,PHIT                               TMCN2730
   70 CONTINUE                                                          TMCN2740
C          * * * * * * * * *                                            TMCN2750
      IF(THETT.GE.ASTOP .OR. PSIT  .GE.ASTOP) GO TO 60                  TMCN2760
      IF(PHIT .GE.ASTOP) GO TO 60                                       TMCN2770
C  70 COSTH = COS(THETT)                                                TMCN2780
C          * * * * * * * * *                                            TMCN2790
      COSTH = COS(THETT)                                                TMCN2800
      SINTH = SIN(THETT)                                                TMCN2810
C        COSPS,SINPS COMPUTED ABOVE EITHER AFTER ST 5 OR AFTER ST 41    TMCN2820
      COSPH = COS(PHIT)                                                 TMCN2830
      SINPH = SIN(PHIT)                                                 TMCN2840
    3 CONTINUE                                                          TMCN2850
      GCTH = G*COSTH                                                    TMCN2860
      GSTH = G*SINTH                                                    TMCN2870
      RETURN                                                            TMCN2880
C          * * * * * * * * *                                            TMCN2890
C      ISTOP.NE.0 CAUSES PRINTING OF OUTPUT UP TO CURRENT RUNGE-KUTTA   TMCN2900
C        INTERVAL, MESSAGE, AND TERMINATION OF THIS RUN AT END OF THIS  TMCN2910
C        INTERVAL IN THE MAIN PROGRAM.                                  TMCN2920
C                                                                       TMCN2930
C                                                                       TMCN2940
   60 ISTOP = 30                                                        TMCN2950
C               AT 64 TEMPORARY ERROR STOP.                             TMCN2960
   64 CALL OUTPUT(2)                                                    TMCN2970
      CALL PLOTTP(3)                                                    TMCN2980
      WRITE(6,1006) T, ISTOP                                            TMCN2990
 1006 FORMAT(7H0 TIME=,F8.3,5X, 7H ISTOP=,I3,21H IN SUBROUTINE TMCNST)  TMCN3000
C     CALL ABDUMP                                                       TMCN3010
C     SUBR ABDUMP CAUSES 'ABNORMAL END' AND DUMP ON OUR OPERATING SYSTEMTMCN3020
      STOP                                                              TMCN3030
C           IF STOP IS CODED AS HERE, DOES NOT RETURN TO MAIN PROGRAM.  TMCN3040
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```
C          * * * * * * * * *
C   64 WRITE(6,1006) T, ISTOP                                    TMCN3050
C      RETURN                                                    TMCN3060
       END                                                       TMCN3070
                                                                 TMCN3080
```

```
      SUBROUTINE TREAD(NCARD,NCRDS,NT,NDIM,ARRAY,NERR)
C             HVOSM-RD2 VERSION
C             REVISED OCTOBER 1975   CALSPAN CORPORATION
      DIMENSION ARRAY(2),DUM(9)
      IF(NT.GT.NDIM) GO TO 90
      K = 0
      LSEQ = 0
      DO10 I=1,NCRDS
      READ(2,2000) (DUM(N),N=1,9),NSEQ,LCARD
 2000 FORMAT(9F8.0,2I4)
      IF(NCARD.NE.LCARD) GO TO 90
      IF(NSEQ.LE.LSEQ) GO TO 90
      LSEQ = NSEQ
      DO 20 N=1,9
      K = K+1
      ARRAY(K) = DUM(N)
      IF(K.GE.NT) GO TO 91
   20 CONTINUE
   10 CONTINUE
   91 RETURN
   90 NERR = 1
      RETURN
      END
```

```
      SUBROUTINE T2READ(NCARD,ND1,NI,NJ,ARRAY,NERR)
C              HVOSM-RD2 VERSION
C              HVOSM-VD2 VERSION
C              REVISED OCTOBER 1975   CALSPAN CORPORATION
      DIMENSION ARRAY(ND1,NJ),DUM(9)
      LSEQ = 0
      NICRDS = (NI-1)/9 + 1
      DO 30 J=1,NJ
      K = 0
      DO 20 I=1,NICRDS
      READ(2,2000) (DUM(N),N=1,9),NSEQ,LCARD
 2000 FORMAT(9F8.0,2I4)
      IF(NCARD.NE.LCARD) GO TO 90
      IF(NSEQ.LE.LSEQ) GO TO 90
      LSEQ = NSEQ
      DO 10 N=1,9
      K = K+1
      ARRAY(K,J) = DUM(N)
      IF(K.GE.NI) GO TO 30
   10 CONTINUE
   20 CONTINUE
   30 CONTINUE
      RETURN
   90 NERR = 1
      RETURN
      END
```

```
      SUBROUTINE UMOMNT(IS)                                             UMOM0010
C              HVOSM-RD2 VERSION                                        UMOM0020
C              REVISED OCTOBER 1975   CALSPAN CORPORATION               UMOM0030
C   SUBROUTINE TO COMPUTE THE MOMENTS ACTING ON THE SPRUNG AND          UMOM0040
C   UNSPRUNG MASSES RESULTING FROM TIRE FORCES AND SUSPENSIN FORCES.    UMOM0050
C                                                                       UMOM0060
      COMMON/INPT/PHIO,THETAO,PSIO,PO,QO,RO,XCOP,YCOP,ZCOP,UO,VO,WO,    UMOM0070
     1            A,B,DEL10,DEL20,DEL30,PHIRO,DEL10D,DEL20D,DEL30D,     UMOM0080
     2            PHIROD,TF,TR,ZF,ZR,RHO,AKRS,XMUR,                     UMOM0090
     3            XMS,XMUF,XIX,XIY,XIZ,XIXZ,CF,AKF,XLAMF,OMEGF,CFP,EPSF,UMOM0100
     4            RF,CR,AKR,XLAMR,OMEGR,CRP,EPSR,RR,TS,THMAX,DTCOMP,TO, UMOM0110
     5            T1,DTCMP1,DTPRNT,MODE,EBAR,EM,AAA,HMAX,HMIN,BET,G,    UMOM0120
     6            HED(36),DADE(3),XIR,X1,Y1,Z1,X2,Y2,Z2,PHIC(50),DELB,  UMOM0130
     7            DELE,DDEL,NDEL,PSIF(50),TQF(50),TQR(50),TB,TE,TINCR,  UMOM0140
     8            NZTAB,NZ5,XBDRY(4,5),PSBDRY(4,5),YBDRY(2,5),NBX(5),   UMOM0150
     9            NBY(5),NTBL1,NTBL2,NTBL3,ZGP(21,21,5)                 UMOM0160
      COMMON/INPT/XB(5),XE(5),XINCR(5),NX(5),YB(5),YE(5),YINCR(5),NY(5),UMOM0170
     1          XXZGP5(21),YYZGP5(21),AMUG(5),PSBDRO(4,5),UVWMIN,PQRMIN UMOM0180
      COMMON /DIMV/X1P,X2P,X3P,X4P,Y1P,Y2P,Y3P,Y4P,Z1P,Z2P,Z3P,Z4P,PHI1,UMOM0190
     1             PHI2,PHI3,PHI4,PSI1,PSI2,PSI3,PSI4,CAYW(4),CBYW(4),  UMOM0200
     2             CGYW(4),ZPGI(4),THGI(4),PHGI(4),CPG(4),SPG(4),CTG(4),UMOM0210
     3             STG(4),CAGZ(4),CBGZ(4),CGGZ(4),D1(4),D2(4),D3(4),    UMOM0220
     4             XLM1(4),XLM2(4),XLM3(4),AMTX(3,3),CMTX(3,4),XGPP(4), UMOM0230
     5             YGPP(4),ZGPP(4),DMATX(10,11),DELTA(4),CAR(4),CBR(4), UMOM0240
     6             CGR(4),FR(4),HI(4),FC(4),TI(4),AX(4),BX(4),CX(4),    UMOM0250
     7             CTXG(4),UG(4),STXG(4),AY(4),BY(4),CY(4),CPYG(4),     UMOM0260
     8             SPYG(4),VG(4),PSIIP(4),PHICI(4),CAC(4),CBC(4),CGC(4),UMOM0270
     9             FCXU(4),FCYU(4),FCZU(4),FS(4),CAXW(4),CBXW(4),CGXW(4)UMOM0280
      COMMON /DIMV/AS(4),BS(4),CS(4),CAS(4),CBS(4),CGS(4),BETP(4),      UMOM0290
     1             BETBR(4),FSXU(4),FSYU(4),FSZU(4),FRXU(4),FRYU(4),    UMOM0300
     2             FRZU(4),FXU(4),FYU(4),FZU(4),SI(4),F1FI(2),F1RI(2),  UMOM0310
     3             F2FI(2),F2RI(2),CAH(4),CBH(4),CGH(4)                 UMOM0320
      DIMENSION XP(4),YP(4),ZP(4),PHII(4),PSII(4)                       UMOM0330
      EQUIVALENCE (XP(1),X1P),(YP(1),Y1P),(ZP(1),Z1P),(PHII(1),PHI1),   UMOM0340
     1            (PSII(1),PSI1)                                        UMOM0350
      COMMON /COMP/SUMM,THETN,PHIN,PSIN,PI,RAD,GAM1,GAM2,GAM3,GAM4,GAM5,UMOM0360
     1            GAM6,GAM7,GAM8,GAM9,THETT,PHIT,PSIT,ZRO,TRO2,         UMOM0370
     2             TFO2,TIZ,RHO2,RHOMUR,AMUF,BMUR,ZPR,TM4,RHMR2,AO2APB, UMOM0380
     3             BO2APB,RFTF,TSO2,RRTS,BROMUR,XMUFO2,AXMFO2,XMTFO4,   UMOM0390
     4             XIZR,RTR,RHMR2I,XIXP,XIZP,XIXZP,XIYZP,D1PD2,D1MD2,   UMOM0400
     5             ZRD3,ZRD3R,ZFD3R,ZFD12,TIZ2,TG61,DD1P2,DD1M2,RPR,PHRPUMOM0410
     6            ,TANTP,SPHTP,CPHTP,SECTP,SFXS,SFYS,SFZS,SNPS,SNTS,    UMOM0420
     7             SNPSS,TPR,CAY,CBY,CGY,CAX,CBX,CGX,SFYU,SFXU,SFYUF,   UMOM0430
     8             SFYUR,SFZU,COSTH,SINTH,COSPS,SINPS,COSPH,SINPH,ANG1, UMOM0440
     9             ANG2,CPHI,SPHI,CPSI,SPSI,P1,P7,P3,P4,P5,P6,TX,TY,TZ  UMOM0450
      COMMON /COMP/TRH,DISTX,DISTY,DISTD,DISTS,D21,ZETA4,ZETA4D,ZETA3,  UMOM0460
     1             ZETA3D,SFZ1,SNPU,SNTU,HCGH1,HCGH2,HCGH3,HCGH4,TERM1, UMOM0470
     2             TERM2,SNPSU,SNPR,HCBH1,HCBH2,HCBH3,HCBH4,HCAH1,HCAH2,UMOM0480
     3             HCAH3,HCAH4,UQ,WP,UR,QR,VP,PR,P2,Q2,R2,VR,WQ,PQ,PHIR2UMOM0490
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     4              ,PHIRD2,RPHRD,GCTH,GSTH,GCTSP,GCTCP,XXX,YYY,IX,IY,XX1,
     5               XX2,YY1,YY2,THG1,THG2,PHG1,PHG2,ZZ1,ZZ2,LLL
      DIMENSION HCAH(4),HCBH(4),HCGH(4)
      EQUIVALENCE (HCAH(1),HCAH1),(HCBH(1),HCBH1),(HCGH(1),HCGH1)
      COMMON /INSUS/ XIF,RHOF,TSF,PHIFO,PHIFOD,DEL40,DEL40D,ISUS,
     1                AKDS,AKDS1,AKDS2,AKDS3,PHIRC(50),DTHF(50),DTHR(50),
     2                NCAMF,NCAMR,NDTHF,NDTHR
      COMMON /SUSCMP/ XMURO2,BXMRO2,XMTRO4,ZFO,TSFO2,RHOF2,RHFMUF,
     1                  RHF2MF,RF2MFI,RTF,RRTR,D3PD4,D3MD4,D43,DD3P4,
     2                  DD3M4,ZFD1RF,ZRD34,RFPF,RPF2M,WFMF,PHFP,PHIF2,
     3                  PHIFD2,RPHFD,ZFD1,ZFD2,ZRD4,TPF,SLOPE3,SLOPE4,
     4                  PHI3D,PHI4D,DTHF1,DTHF2,DTHR3,DTHR4,DTDD1,
     5                  DTDD2,DTDD3,DTDD4,FJF(4),SNPF
C
      IS1 = IS+1
      GO TO (10,20,30),IS1
C
C   MOMENTS FOR SUSPENSION OPTION 0 , INDEPENDENT FRONT, SOLID AXLE REAR
C
   10 TERM1 = ZFD1+HCGH1
      TERM2 = ZFD2+HCGH2
C
C   ROLL MOMENT
C
      SNPU = -FYU(1)*TERM1 - FYU(2)*TERM2 - (FYU(3)+FYU(4))*ZRD3
     1       +SI(2)*(TFO2+DTHF2) - SI(1)*(TFO2+DTHF1)
     2       +(SI(4)-SI(3))*TSO2
C
C   PITCH MOMENT
C
      SNTU =  (SI(1)+SI(2))*A - (SI(3)+SI(4))*B
     1       +FXU(1)*TERM1 + FXU(2)*TERM2
     2       +FXU(3)*(ZRD3R+TPR+HCGH3) + FXU(4)*(ZRD3R-TPR+HCGH4)
C
C   YAW MOMENT
C
      SNPSU = FYU(1)*(A+HCAH1) + FYU(2)*(A+HCAH2)
     1       -FYU(3)*(B-HCAH3) - FYU(4)*(B-HCAH4)
     2       -FXU(1)*(TFO2+DTHF1+HCBH1) + FXU(2)*(TFO2+DTHF2-HCBH2)
     3       -FXU(3)*(TRO2-RPR+HCBH3) + FXU(4)*(TRO2+RPR-HCBH4)
C
C   REAR AXLE ROLL MOMENT
C
      SNPR =  FZU(3)*(TRO2-RPR+HCBH3) - FZU(4)*(TRO2+RPR-HCBH4)
     1       -FYU(3)*(RHO+TPR+HCGH3)  - FYU(4)*(RHO-TPR+HCGH4)
     2       +(SI(3)-SI(4))*TSO2
      RETURN
C
C   MOMENTS FOR SUSPENSION OPTION 1, INDEPENDENT FRONT AND REAR
C
   20 TERM1 = ZFD1+HCGH1
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```
      TERM2 = ZFD2+HCGH2
      TERM3 = ZRD3+HCGH3
      TERM4 = ZRD4+HCGH4
C
C  ROLL MOMENT
C
      SNPU =  SI(2)*(TFO2+DTHF2) - SI(1)*(TFO2+DTHF1)
     1        +SI(4)*(TRO2+DTHR4) - SI(3)*(TRO2+DTHR3)
     2        -FYU(1)*TERM1 - FYU(2)*TERM2 - FYU(3)*TERM3 - FYU(4)*TERM4
C
C  PITCH MOMENT
C
      SNTU = (SI(1)+SI(2))*A - (SI(3)+SI(4))*B
     1        +FXU(1)*TERM1 + FXU(2)*TERM2 + FXU(3)*TERM3 + FXU(4)*TERM4
C
C  YAW MOMENT
C
      SNPSU = FYU(1)*(A+HCAH1) + FYU(2)*(A+HCAH2)
     1        -FYU(3)*(B-HCAH3) - FYU(4)*(B-HCAH4)
     2        -FXU(1)*(TFO2+DTHF1+HCBH1) + FXU(2)*(TFO2+DTHF2-HCBH2)
     3        -FXU(3)*(TRO2+DTHR3+HCBH3) + FXU(4)*(TRO2+DTHR4-HCBH4)
      RETURN
C
C  MOMENTS FOR SUSPENSION OPTION 2, SOLID FRONT AND REAR AXLES
C
C  ROLL MOMENT
C
   30 SNPU = -(FYU(1)+FYU(2))*ZFD1 - (FYU(3)+FYU(4))*ZRD3
     1        +(SI(2)-SI(1))*TSFO2  + (SI(4)-SI(3))*TSO2
C
C  PITCH MOMENT
C
      SNTU =  (SI(1)+SI(2))*A - (SI(3)+SI(4))*B
     1        +FXU(1)*(ZFD1RF+TPF+HCGH1) + FXU(2)*(ZFD1RF-TPF+HCGH2)
     2        +FXU(3)*(ZRD3R+TPR+HCGH3)  + FXU(4)*(ZRD3R-TPR+HCGH4)
C
C  YAW MOMENT
C
      SNPSU = FYU(1)*(A+HCAH1) + FYU(2)*(A+HCAH2)
     1        -FYU(3)*(B-HCAH3) - FYU(4)*(B-HCAH4)
     2        -FXU(1)*(TFO2-RFPF+HCBH1) + FXU(2)*(TFO2+RFPF-HCBH2)
     3        -FXU(3)*(TRO2-RPR+HCBH3)  + FXU(4)*(TRO2+RPR-HCBH4)
C
C  FRONT AXLE ROLL MOMENT
C
      SNPF =  FZU(1)*(TFO2-RFPF+HCBH1) - FZU(2)*(TFO2+RFPF-HCBH2)
     1        -FYU(1)*(RHOF+TPF+HCGH1)  - FYU(2)*(RHOF-TPF+HCGH2)
     2        +(SI(1)-SI(2))*TSFO2
C
C  REAR AXLE ROLL MOMENT
C
```

```
      SNPR =  FZU(3)*(TRO2-RPR+HCBH3) - FZU(4)*(TRO2+RPR-HCBH4)
     1       -FYU(3)*(RHO+TPR+HCGH3)  - FYU(4)*(RHO-TPR+HCGH4)
     2       +(SI(3)-SI(4))*TSO2 -
      RETURN
      END
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      SUBROUTINE VGORNT
C          HVOSM-RD2 VERSION
C          REVISED OCTOBER 1975  CALSPAN CORPORATION
      COMMON/INPT/PHIO,THETAO,PSIO,PO,QO,RO,XCOP,YCOP,ZCOP,UO,VO,WO,
     1           A,B,DEL1O,DEL2O,DEL3O,PHIRO,DEL1OD,DEL2OD,DEL3OD,
     2           PHIROD,TF,TR,ZF,ZR,RHO,AKRS,XMUR,
     3           XMS,XMUF,XIX,XIY,XIZ,XIXZ,CF,AKF,XLAMF,OMEGF,CFP,EPSF,
     4           RF,CR,AKR,XLAMR,OMEGR,CRP,EPSR,RR,TS,THMAX,DTCOMP,TO,
     5           T1,DTCMP1,DTPRNT,MODE,EBAR,EM,AAA,HMAX,HMIN,BET,G,
     6           HED(36),DADE(3),XIR,X1,Y1,Z1,X2,Y2,Z2,PHIC(50),DELB,
     7           DELE,DDEL,NDEL,PSIF(50),TQF(50),TQR(50),TB,TE,TINCR,
     8           NZTAB,NZ5,XBDRY(4,5),PSBDRY(4,5),YBDRY(2,5),NBX(5),
     9           NBY(5),NTBL1,NTBL2,NTBL3,ZGP(21,21,5)
      COMMON/INPT/XB(5),XE(5),XINCR(5),NX(5),YB(5),YE(5),YINCR(5),NY(5),
     1         XXZGP5(21),YYZGP5(21),AMUG(5),PSBDRO(4,5),UVWMIN,PQRMIN
      COMMON/INPT1/YC1P,YC2P,ZC2P,DELTC,PHIC1,PHIC2,AMUC,XIPS,
     1           CPSP,OMGPS,AKPS,EPSPS,XPS,RWHJB,RWHJE,DRWHJ,INDCRB,
     2           PSIFIO,PSIFDO
      DIMENSION YCIP(2)
      EQUIVALENCE (YCIP(1),YC1P)
      COMMON /INTG/NEQ,T,DT,VAR(50),DER(50)
      EQUIVALENCE (U,VAR(1)),(V,VAR(2)),(W,VAR(3)),(P,VAR(4)),(Q,VAR(5))
     1          ,(R,VAR(6)),(DEL1,VAR(7)),(DEL1D,VAR(8)),(DEL2,VAR(9)),
     2           (DEL2D,VAR(10)),(DEL3,VAR(11)),(DEL3D,VAR(12)),
     3           (PHIR,VAR(13)),(PHIRD,VAR(14)),(THETTP,VAR(15)),
     4           (PHITP,VAR(16)),(PSITP,VAR(17)),(XCP,VAR(18)),
     5           (YCP,VAR(19)),(ZCP,VAR(20)),(PSIFI,VAR(21)),
     6           (PSIFID,VAR(22))
      EQUIVALENCE (DU,DER(1)),(DV,DER(2)),(DW,DER(3)),(DP,DER(4)),
     1           (DQ,DER(5)),(DR,DER(6)),(DDEL1,DER(7)),(DDEL1D,DER(8))
     2          ,(DDEL2,DER(9)),(DDEL2D,DER(10)),(DDEL3,DER(11)),
     3           (DDEL3D,DER(12)),(DPHIR,DER(13)),(DPHIRD,DER(14)),
     4           (DTHTTP,DER(15)),(DPHITP,DER(16)),(DPSITP,DER(17)),
     5           (DXCP,DER(18)),(DYCP,DER(19)),(DZCP,DER(20)),
     6           (DPSIFI,DER(21)),(DDPSFI,DER(22))
      EQUIVALENCE (VAR(9),PHIF),(VAR(10),PHIFD),(DER(9),DPHIF),
     1           (DER(10),DPHIFD)
      EQUIVALENCE (VAR(13),DEL4),(VAR(14),DEL4D),(DER(13),DDEL4),
     1           (DER(14),DDEL4D)
      COMMON /DIMV/X1P,X2P,X3P,X4P,Y1P,Y2P,Y3P,Y4P,Z1P,Z2P,Z3P,Z4P,PHI1,
     1            PHI2,PHI3,PHI4,PSI1,PSI2,PSI3,PSI4,CAYW(4),CBYW(4),
     2            CGYW(4),ZPGI(4),THGI(4),PHGI(4),CPG(4),SPG(4),CTG(4),
     3            STG(4),CAGZ(4),CBGZ(4),CGGZ(4),D1(4),D2(4),D3(4),
     4            XLM1(4),XLM2(4),XLM3(4),AMTX(3,3),CMTX(3,4),XGPP(4),
     5            YGPP(4),ZGPP(4),DMATX(10,11),DELTA(4),CAR(4),CBR(4),
     6            CGR(4),FR(4),HI(4),FC(4),TI(4),AX(4),BX(4),CX(4),
     7            CTXG(4),UG(4),STXG(4),AY(4),BY(4),CY(4),CPYG(4),
     8            SPYG(4),VG(4),PSIIP(4),PHICI(4),CAC(4),CBC(4),CGC(4),
     9            FCXU(4),FCYU(4),FCZU(4),FS(4),CAXW(4),CBXW(4),CGXW(4)
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      COMMON /DIMV/AS(4),BS(4),CS(4),CAS(4),CBS(4),CGS(4),BETP(4),      VGOR0500
     1             BETBR(4),FSXU(4),FSYU(4),FSZU(4),FRXU(4),FRYU(4),    VGOR0510
     2             FRZU(4),FXU(4),FYU(4),FZU(4),SI(4),F1FI(2),F1RI(2),  VGOR0520
     3             F2FI(2),F2RI(2),CAH(4),CBH(4),CGH(4)                 VGOR0530
      DIMENSION XP(4),YP(4),ZP(4),PHII(4),PSII(4)                       VGOR0540
      EQUIVALENCE (XP(1),X1P),(YP(1),Y1P),(ZP(1),Z1P),(PHII(1),PHI1),   VGOR0550
     1            (PSII(1),PSI1)                                        VGOR0560
      COMMON /COMP/SUMM,THETN,PHIN,PSIN,PI,RAD,GAM1,GAM2,GAM3,GAM4,GAM5,VGOR0570
     1            GAM6,GAM7,GAM8,GAM9,THETT,PHIT,PSIT,ZRO,TRO2,         VGOR0580
     2             TFO2,TIZ,RHO2,RHOMUR,AMUF,BMUR,ZPR,TM4,RHMR2,AO2APB, VGOR0590
     3             BO2APB,RFTF,TSO2,RRTS,BROMUR,XMUFO2,AXMFO2,XMTFO4,   VGOR0600
     4             XIZR,RTR,RHMR2I,XIXP,XIZP,XIXZP,XIYZP,D1PD2,D1MD2,   VGOR0610
     5             ZRD3,ZRD3R,ZFD3R,ZFD12,TIZ2,TG61,DD1P2,DD1M2,RPR,PHRPVGOR0620
     6            ,TANTP,SPHTP,CPHTP,SECTP,SFXS,SFYS,SFZS,SNPS,SNTS,    VGOR0630
     7             SNPSS,TPR,CAY,CBY,CGY,CAX,CBX,CGX,SFYU,SFXU,SFYUF,   VGOR0640
     8             SFYUR,SFZU,COSTH,SINTH,COSPS,SINPS,COSPH,SINPH,ANG1, VGOR0650
     9             ANG2,CPHI,SPHI,CPSI,SPSI,P1,P7,P3,P4,P5,P6,TX,TY,TZ  VGOR0660
      COMMON /COMP/TRH,DISTX,DISTY,DISTD,DISTS,D21,ZETA4,ZETA4D,ZETA3,  VGOR0670
     1             ZETA3D,SFZ1,SNPU,SNTU,HCGH1,HCGH2,HCGH3,HCGH4,TERM1, VGOR0680
     2             TERM2,SNPSU,SNPR,HCBH1,HCBH2,HCBH3,HCBH4,HCAH1,HCAH2,VGOR0690
     3             HCAH3,HCAH4,UQ,WP,UR,QR,VP,PR,P2,Q2,R2,VR,WQ,PQ,PHIR2VGOR0700
     4            ,PHIRD2,RPHRD,GCTH,GSTH,GCTSP,GCTCP,XXX,YYY,IX,IY,XX1,VGOR0710
     5             XX2,YY1,YY2,THG1,THG2,PHG1,PHG2,ZZ1,ZZ2,LLL          VGOR0720
      DIMENSION HCAH(4),HCBH(4),HCGH(4)                                 VGOR0730
      EQUIVALENCE (HCAH(1),HCAH1),(HCBH(1),HCBH1),(HCGH(1),HCGH1)       VGOR0740
      COMMON /COMPN/ FRSP(4),FRCP(4),ICBHIT,JCBHIT,                     VGOR0750
     1               DPSINT,TANPC1,TANPC2,PHIC1R,PHIC2R,AMUCMP,PHI1D,   VGOR0760
     2               PHI2D,LCB1(4),LCB2(4),IHIT,AJMTX(3,3),BMTX(3,3),   VGOR0770
     3               SFRX(4),SFRY(4),SFRZ(4),T1PSI,T2PSI,XMUGI(4)       VGOR0780
      LOGICAL LCB1,LCB2                                                 VGOR0790
      COMMON/ADTNL/ U1,U2,U3,U4,V1,V2,V3,V4,W1,W2,W3,W4,                VGOR0800
     1              XIYP,SPHIC,CPHIC,APTCH1,APTCH2,APTCH3,APTCH4,       VGOR0810
     2              SLOPE1,SLOPE2,XTRA(300)                             VGOR0820
      DIMENSION UI(4),VI(4),WI(4)                                       VGOR0830
      EQUIVALENCE (UI(1),U1),(VI(1),V1),(WI(1),W1)                      VGOR0840
      DIMENSION APITCH(4)                                               VGOR0850
      EQUIVALENCE (APITCH(1),APTCH1)                                    VGOR0860
      COMMON /TIRIN/ AKT(4),SIGT(4),XLAMT(4),A0(4),A1(4),A2(4),A3(4),   VGOR0870
     1               A4(4),OMEGT(4),AMU(4),RW(4),FJP(35,4),A234(4),     VGOR0880
     2               A12(4),OMT2A2(4),OMT2M1(4),A23(4),ITIR(4)          VGOR0890
      COMMON /INSUS/ XIF,RHOF,TSF,PHIFO,PHIFOD,DEL40,DEL40D,ISUS,       VGOR0900
     1               AKDS,AKDS1,AKDS2,AKDS3,PHIRC(50),DTHF(50),DTHR(50),VGOR0910
     2               NCAMF,NCAMR,NDTHF,NDTHR                            VGOR0920
      COMMON /SUSCMP/ XMURO2,BXMRO2,XMTRO4,ZFO,TSFO2,RHOF2,RHFMUF,      VGOR0930
     1                RHF2MF,RF2MFI,RTF,RRTR,D3PD4,D3MD4,D43,DD3P4,     VGOR0940
     2                DD3M4,ZFD1RF,ZRD34,RFPF,RPF2M,WFMF,PHFP,PHIF2,    VGOR0950
     3                PHIFD2,RPHFD,ZFD1,ZFD2,ZRD4,TPF,SLOPE3,SLOPE4,    VGOR0960
     4                PHI3D,PHI4D,DTHF1,DTHF2,DTHR3,DTHR4,DTDD1,        VGOR0970
     5                DTDD2,DTDD3,DTDD4,FJF(4),SNPF                     VGOR0980
      COMMON/NEWCRB/ YC3P,YC4P,YC5P,YC6P,YCLP,                          VGOR0990
     1               ZC3P,ZC4P,ZC5P,ZC6P,ZCLP,                          VGOR1000
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     2             PHIC3,PHIC4,PHIC5,PHIC6,NCRBSL,
     3             TANPC3,TANPC4,TANPC5,TANPC6,TANPCL,
     4             PHIC3R,PHIC4R,PHIC5R,PHIC6R,PHICLR,
     5             YCMP(6),ZCMP(6),PHICM(6)
      COMMON /RUFNES/ DELG,DGMAX,NEND,IRUF
    1 DO 17  I=1,4
      XCPHI = COS(PHII(I))
      XSPHI = SIN(PHII(I))
      XCPSI = COS(PSII(I))
      XSPSI = SIN(PSII(I))
      TMP4 =   XCPHI * XCPSI
      TMP3 =   XSPHI * XCPSI
    2 CAYW(I) =-AMTX(1,1)*XSPSI+ AMTX(1,2)*TMP4 + AMTX(1,3)*TMP3
      CBYW(I) =-AMTX(2,1)*XSPSI+ AMTX(2,2)*TMP4 + AMTX(2,3)*TMP3
      CGYW(I) =-AMTX(3,1)*XSPSI+ AMTX(3,2)*TMP4 + AMTX(3,3)*TMP3
      IF(INDCRB.LE.0) GO TO 3
      LCB1(I) = RW(I).GT.YC1P-YP(I)
      LCB2(I) = RW(I).LE.YP(I)-YCLP
      IF(ICBHIT.EQ.0) GO TO 3
      PHGI(I) = 0.0
      THGI(I) = 0.0
      ZPGI(I) = 0.0
      SPG(I) = 0.0
      CPG(I) = 1.0
      STG(I) = 0.0
      CTG(I) = 1.0
      IF(.NOT.LCB2(I)) GO TO 4
      ZPGI(I) = ZCLP+(YP(I)-YCLP)*TANPCL
      PHGI(I) = PHICLR
      SPG(I) = SIN(PHGI(I))
      CPG(I) = COS(PHGI(I))
      GO TO 30
C          INTRP5 LOOKS UP THGI, PHGI, ZPGI, AND XMUGI FOR EACH WHEEL.
    3 IF(IRUF.EQ.0) GO TO 31
      IF(XP(I)+RW(I).LT.0.0.OR.XP(I)-RW(I).GT.DGMAX) GO TO 31
      CALL RUFFRC(I,ZGP)
      XMUGI(I) = AMU(I)
      GO TO 33
   31 CALL INTRP5(I)
   32 CPG(I) = COS(PHGI(I))
      SPG(I) = SIN(PHGI(I))
      CTG(I) = COS(THGI(I))
      STG(I) = SIN(THGI(I))
   30 CAGZ(I) = CPG(I)*STG(I)
      CBGZ(I) = -SPG(I)
      CGGZ(I) = CTG(I)*CPG(I)
      P1 = CBYW(I)*CGGZ(I)
      P7 = CBGZ(I)*CGYW(I)
      P3 = CGYW(I)*CAGZ(I)
      P4 = CGGZ(I)*CAYW(I)
      P5 = CAYW(I)*CBGZ(I)
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      P6 = CAGZ(I)*CBYW(I)
      D1(I) = P1-P7
      D2(I) = P3-P4
      D3(I) = P5-P6
      CALL GCP(I)
C             XMUGI(I) IS SET IN INTRP5
C             IF ICBHIT.NE.0 AND LCB1(I) AND LCB2(I) BOTH  FALSE,  XMUGI(I)
C              IS NOT SET IN THIS INTERVAL.  RETAINS LAST VALUE, SHOULD BE
C                   FOR FLAT TERRAIN. (RADIAL SPRING TIRE MODE IN CRBIMP
C              REQUIRES FLAT TERRAIN  PREVIOUS TO CURB HIT.)
      GO TO 5
    4 IF(.NOT.LCB1(I))GO TO 30
      CALL CRBIMP(I)
      XMUGI(I) = AMUC*AMU(I)
   33 CAGZ(I) = CPG(I)*STG(I)
      CBGZ(I) = -SPG(I)
      CGGZ(I) = CTG(I)*CPG(I)
      P1 = CBYW(I)*CGGZ(I)
      P7 = CBGZ(I)*CGYW(I)
      P3 = CGYW(I)*CAGZ(I)
      P4 = CGGZ(I)*CAYW(I)
      P5 = CAYW(I)*CBGZ(I)
      P6 = CAGZ(I)*CBYW(I)
      D1(I) = P1-P7
      D2(I) = P3-P4
      D3(I) = P5-P6
    5 CAH(I) = AMTX(1,1)*CAR(I)+AMTX(2,1)*CBR(I)+AMTX(3,1)*CGR(I)
      CBH(I) = AMTX(1,2)*CAR(I)+AMTX(2,2)*CBR(I)+AMTX(3,2)*CGR(I)
      CGH(I) = AMTX(1,3)*CAR(I)+AMTX(2,3)*CBR(I)+AMTX(3,3)*CGR(I)
      TI(I) = 12.0*TI(I)/HI(I)
      HCAH(I) = HI(I)*CAH(I)
      HCBH(I) = HI(I)*CBH(I)
      HCGH(I) = HI(I)*CGH(I)
   17 CONTINUE
C
      IF(ISUS.NE.0) GO TO 90
      V1 = V+A*R-ZFD1*P-HCGH1*(P+PHI1D)+DTDD1*DEL1D
      V2 = V+A*R-ZFD2*P-HCGH2*(P+PHI2D)-DTDD2*DEL2D
      V3 = V-B*R-ZRD3*P-(RHO+TPR+HCGH3)*(P+PHIRD)
      V4 = V-B*R-ZRD3*P-(RHO-TPR+HCGH4)*(P+PHIRD)
      W1 = W-A*Q+(TFO2+DTHF1)*P+DEL1D+HCBH1*(P+PHI1D)
      W2 = W-A*Q-(TFO2+DTHF2)*P+DEL2D+HCBH2*(P+PHI2D)
      W3 = W+B*Q+DEL3D-(RPR-TRO2-HCBH3)*(P+PHIRD)
      W4 = W+B*Q+DEL3D-(RPR+TRO2-HCBH4)*(P+PHIRD)
      GO TO 95
   90 IF(ISUS.EQ.2) GO TO 91
      V1 = V+A*R-ZFD1*P-HCGH1*(P+PHI1D)+DTDD1*DEL1D
      V2 = V+A*R-ZFD2*P-HCGH2*(P+PHI2D)-DTDD2*DEL2D
      V3 = V-B*R-ZRD3*P-HCGH3*(P+PHI3D)+DTDD3*DEL3D
      V4 = V-B*R-ZRD4*P-HCGH4*(P+PHI4D)-DTDD4*DEL4D
      W1 = W-A*Q+(TFO2+DTHF1)*P+DEL1D+HCBH1*(P+PHI1D)
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      W2 = W-A*Q-(TFO2+DTHF2)*P+DEL2D+HCBH2*(P+PHI2D)
      W3 = W+B*Q+(TRO2+DTHR3)*P+DEL3D+HCBH3*(P+PHI3D)
      W4 = W+B*Q-(TRO2+DTHR4)*P+DEL4D+HCBH4*(P+PHI4D)
      GO TO 95
   91 V1 = V+A*R-ZFD1*P-(RHOF+TPF+HCGH1)*(P+PHIFD)
      V2 = V+A*R-ZFD1*P-(RHOF-TPF+HCGH2)*(P+PHIFD)
      V3 = V-B*R-ZRD3*P-(RHO+TPR+HCGH3)*(P+PHIRD)
      V4 = V-B*R-ZRD3*P-(RHO-TPR+HCGH4)*(P+PHIRD)
      W1 = W-A*Q+DEL1D-(RFPF-TFO2-HCBH1)*(P+PHIFD)
      W2 = W-A*Q+DEL1D-(RFPF+TFO2-HCBH2)*(P+PHIFD)
      W3 = W+B*Q+DEL3D-(RPR-TRO2-HCBH3)*(P+PHIRD)
      W4 = W+B*Q+DEL3D-(RPR+TRO2-HCBH4)*(P+PHIRD)
C
   95 DO 170 I=1,4
   10 AX(I) = CBY*CGGZ(I)-CGY*CBGZ(I)
      BX(I) = CGY*CAGZ(I)-CAY*CGGZ(I)
      CX(I) = CAY*CBGZ(I)-CBY*CAGZ(I)
      DISTX = SQRT(AX(I)**2+BX(I)**2+CX(I)**2)
      CTXG(I) = (CAX*AX(I)+CBX*BX(I)+CGX*CX(I))/DISTX
      CTXG(I) = SIGN(AMIN1(ABS(CTXG(I)),1.0),CTXG(I))
      STXG(I) = SIGN(SQRT(1.0-CTXG(I)**2),CGX*DISTX-CX(I))
      UG(I) = UI(I)*CTXG(I)-WI(I)*STXG(I)
   11 AY(I) = CGX*CBGZ(I)-CBX*CGGZ(I)
      BY(I) = CAX*CGGZ(I)-CGX*CAGZ(I)
      CY(I) = CBX*CAGZ(I)-CAX*CBGZ(I)
      DISTY = SQRT(AY(I)**2+BY(I)**2+CY(I)**2)
   12 CPYG(I) = (CAY*AY(I)+CBY*BY(I)+CGY*CY(I))/DISTY
      CPYG(I) = SIGN(AMIN1(ABS(CPYG(I)),1.0),CPYG(I))
      SPYG(I) = SIGN(SQRT(1.0-CPYG(I)**2),CGY*DISTY-CY(I))
      VG(I) = VI(I)*CPYG(I)-WI(I)*SPYG(I)
      DISTD = SQRT(D1(I)**2+D2(I)**2+D3(I)**2)
   13 CAZW = - AMTX(1,2)*XSPHI + AMTX(1,3)*XCPHI
      CBZW = - AMTX(2,2)*XSPHI + AMTX(2,3)*XCPHI
      CGZW = - AMTX(3,2)*XSPHI + AMTX(3,3)*XCPHI
      PSIIP(I) = PSII(I)*(CAGZ(I)*CAZW+CBGZ(I)*CBZW+CGGZ(I)*CGZW)
   14 CAC(I) = D1(I)/DISTD
      CBC(I) = D2(I)/DISTD
      CGC(I) = D3(I)/DISTD
C           CAXW(I),CBXW(I),CGXW(I)  NO LONGER USED
   15 AS(I) = CGC(I)*CBGZ(I)-CBC(I)*CGGZ(I)
      BS(I) = CAC(I)*CGGZ(I)-CGC(I)*CAGZ(I)
      CS(I) = CBC(I)*CAGZ(I)-CAC(I)*CBGZ(I)
      DISTS = SQRT(AS(I)**2+BS(I)**2+CS(I)**2)
      CAS(I) = AS(I)/DISTS
      CBS(I) = BS(I)/DISTS
      CGS(I) = CS(I)/DISTS
   16 CALL TIRFRC(I)
  170 CONTINUE
      RETURN
      END
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      SUBROUTINE VPOS                                                   VPOS0010
C           HVOSM-RD2 VERSION                                           VPOS0020
C           REVISED OCTOBER 1975   CALSPAN CORPORATION                  VPOS0030
      COMMON/INPT/PHIO,THETAO,PSIO,PO,QO,RO,XCOP,YCOP,ZCOP,UO,VO,WO,    VPOS0040
     1            A,B,DEL10,DEL20,DEL30,PHIRO,DEL10D,DEL20D,DEL30D,     VPOS0050
     2            PHIROD,TF,TR,ZF,ZR,RHO,AKRS,XMUR,                     VPOS0060
     3            XMS,XMUF,XIX,XIY,XIZ,XIXZ,CF,AKF,XLAMF,OMEGF,CFP,EPSF,VPOS0070
     4            RF,CR,AKR,XLAMR,OMEGR,CRP,EPSR,RR,TS,THMAX,DTCOMP,TO, VPOS0080
     5            T1,DTCMP1,DTPRNT,MODE,EBAR,EM,AAA,HMAX,HMIN,BET,G,    VPOS0090
     6            HED(36),DADE(3),XIR,X1,Y1,Z1,X2,Y2,Z2,PHIC(50),DELB,  VPOS0100
     7            DELE,DDEL,NDEL,PSIF(50),TQF(50),TQR(50),TB,TE,TINCR,  VPOS0110
     8            NZTAB,NZ5,XBDRY(4,5),PSBDRY(4,5),YBDRY(2,5),NBX(5),   VPOS0120
     9            NBY(5),NTBL1,NTBL2,NTBL3,ZGP(21,21,5)                 VPOS0130
      COMMON/INPT/XB(5),XE(5),XINCR(5),NX(5),YB(5),YE(5),YINCR(5),NY(5),VPOS0140
     1         XXZGP5(21),YYZGP5(21),AMUG(5),PSBDRO(4,5),UVWMIN,PQRMIN  VPOS0150
      COMMON/INPT1/YC1P,YC2P,ZC2P,DELTC,PHIC1,PHIC2,AMUC,XIPS,          VPOS0160
     1             CPSP,OMGPS,AKPS,EPSPS,XPS,RWHJB,RWHJE,DRWHJ,INDCRB,  VPOS0170
     2             PSIFIO,PSIFDO                                        VPOS0180
      DIMENSION YCIP(2)                                                 VPOS0190
      EQUIVALENCE (YCIP(1),YC1P)                                        VPOS0200
      COMMON /INTG/NEQ,T,DT,VAR(50),DER(50)                             VPOS0210
      EQUIVALENCE (U,VAR(1)),(V,VAR(2)),(W,VAR(3)),(P,VAR(4)),(Q,VAR(5))VPOS0220
     1          ,(R,VAR(6)),(DEL1,VAR(7)),(DEL1D,VAR(8)),(DEL2,VAR(9)),VPOS0230
     2            (DEL2D,VAR(10)),(DEL3,VAR(11)),(DEL3D,VAR(12)),       VPOS0240
     3            (PHIR,VAR(13)),(PHIRD,VAR(14)),(THETTP,VAR(15)),      VPOS0250
     4            (PHITP,VAR(16)),(PSITP,VAR(17)),(XCP,VAR(18)),        VPOS0260
     5            (YCP,VAR(19)),(ZCP,VAR(20)),(PSIFI,VAR(21)),          VPOS0270
     6            (PSIFID,VAR(22))                                      VPOS0280
      EQUIVALENCE (DU,DER(1)),(DV,DER(2)),(DW,DER(3)),(DP,DER(4)),      VPOS0290
     1            (DQ,DER(5)),(DR,DER(6)),(DDEL1,DER(7)),(DDEL1D,DER(8))VPOS0300
     2          ,(DDEL2,DER(9)),(DDEL2D,DER(10)),(DDEL3,DER(11)),       VPOS0310
     3            (DDEL3D,DER(12)),(DPHIR,DER(13)),(DPHIRD,DER(14)),    VPOS0320
     4            (DTHTTP,DER(15)),(DPHITP,DER(16)),(DPSITP,DER(17)),   VPOS0330
     5            (DXCP,DER(18)),(DYCP,DER(19)),(DZCP,DER(20)),         VPOS0340
     6            (DPSIFI,DER(21)),(DDPSFI,DER(22))                     VPOS0350
      EQUIVALENCE (VAR(9),PHIF),(VAR(10),PHIFD),(DER(9),DPHIF),         VPOS0360
     1            (DER(10),DPHIFD)                                      VPOS0370
      EQUIVALENCE (VAR(13),DEL4),(VAR(14),DEL4D),(DER(13),DDEL4),       VPOS0380
     1            (DER(14),DDEL4D)                                      VPOS0390
      COMMON /DIMV/X1P,X2P,X3P,X4P,Y1P,Y2P,Y3P,Y4P,Z1P,Z2P,Z3P,Z4P,PHI1,VPOS0400
     1             PHI2,PHI3,PHI4,PSI1,PSI2,PSI3,PSI4,CAYW(4),CBYW(4),  VPOS0410
     2             CGYW(4),ZPGI(4),THGI(4),PHGI(4),CPG(4),SPG(4),CTG(4),VPOS0420
     3             STG(4),CAGZ(4),CBGZ(4),CGGZ(4),D1(4),D2(4),D3(4),    VPOS0430
     4             XLM1(4),XLM2(4),XLM3(4),AMTX(3,3),CMTX(3,4),XGPP(4), VPOS0440
     5             YGPP(4),ZGPP(4),DMATX(10,11),DELTA(4),CAR(4),CBR(4), VPOS0450
     6             CGR(4),FR(4),HI(4),FC(4),TI(4),AX(4),BX(4),CX(4),    VPOS0460
     7             CTXG(4),UG(4),STXG(4),AY(4),BY(4),CY(4),CPYG(4),     VPOS0470
     8             SPYG(4),VG(4),PSIIP(4),PHICI(4),CAC(4),CBC(4),CGC(4),VPOS0480
     9             FCXU(4),FCYU(4),FCZU(4),FS(4),CAXW(4),CBXW(4),CGXW(4)VPOS0490
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      COMMON /DIMV/AS(4),BS(4),CS(4),CAS(4),CBS(4),CGS(4),BETP(4),        VPOS0500
     1           BETBR(4),FSXU(4),FSYU(4),FSZU(4),FRXU(4),FRYU(4),        VPOS0510
     2           FRZU(4),FXU(4),FYU(4),FZU(4),SI(4),F1F1(2),F1RI(2),      VPOS0520
     3           F2F1(2),F2RI(2),CAH(4),CBH(4),CGH(4)                     VPOS0530
      DIMENSION XP(4),YP(4),ZP(4),PHII(4),PSII(4)                          VPOS0540
      EQUIVALENCE (XP(1),X1P),(YP(1),Y1P),(ZP(1),Z1P),(PHII(1),PHI1),     VPOS0550
     1           (PSII(1),PSI1)                                            VPOS0560
      COMMON /COMP/SUMM,THETN,PHIN,PSIN,PI,RAD,GAM1,GAM2,GAM3,GAM4,GAM5,VPOS0570
     1          GAM6,GAM7,GAM8,GAM9,THETT,PHIT,PSIT,ZRO,TRO2,             VPOS0580
     2           TFO2,TIZ,RHO2,RHOMUR,AMUF,BMUR,ZPR,TM4,RHMR2,AO2APB,     VPOS0590
     3           BO2APB,RFTF,TSO2,RRTS,BROMUR,XMUFO2,AXMFO2,XMTFO4,       VPOS0600
     4           XIZR,RTR,RHMR2I,XIXP,XIZP,XIXZP,XIYZP,D1PD2,D1MD2,       VPOS0610
     5           ZRD3,ZRD3R,ZFD3R,ZFD12,TIZ2,TG61,DD1P2,DD1M2,RPR,PHRPVPOS0620
     6          ,TANTP,SPHTP,CPHTP,SECTP,SFXS,SFYS,SFZS,SNPS,SNTS,        VPOS0630
     7           SNPSS,TPR,CAY,CBY,CGY,CAX,CBX,CGX,SFYU,SFXU,SFYUF,       VPOS0640
     8           SFYUR,SFZU,COSTH,SINTH,COSPS,SINPS,COSPH,SINPH,ANG1,     VPOS0650
     9           ANG2,CPHI,SPHI,CPSI,SPSI,P1,P7,P3,P4,P5,P6,TX,TY,TZ      VPOS0660
      COMMON /COMP/TRH,DISTX,DISTY,DISTD,DISTS,D21,ZETA4,ZETA4D,ZETA3,    VPOS0670
     1           ZETA3D,SFZ1,SNPU,SNTU,HCGH1,HCGH2,HCGH3,HCGH4,TERM1,     VPOS0680
     2           TERM2,SNPSU,SNPR,HCBH1,HCBH2,HCBH3,HCBH4,HCAH1,HCAH2,VPOS0690
     3           HCAH3,HCAH4,UQ,WP,UR,QR,VP,PR,P2,Q2,R2,VR,WQ,PQ,PHIR2VPOS0700
     4          ,PHIRD2,RPHRD,GCTH,GSTH,GCTSP,GCTCP,XXX,YYY,IX,IY,XX1,VPOS0710
     5           XX2,YY1,YY2,THG1,THG2,PHG1,PHG2,ZZ1,ZZ2,LLL              VPOS0720
      DIMENSION HCAH(4),HCBH(4),HCGH(4)                                    VPOS0730
      EQUIVALENCE (HCAH(1),HCAH1),(HCBH(1),HCBH1),(HCGH(1),HCGH1)         VPOS0740
      COMMON /COMPN/ FRSP(4),FRCP(4),ICBHIT,JCBHIT,                        VPOS0750
     1               DPSINT,TANPC1,TANPC2,PHIC1R,PHIC2R,AMUCMP,PHI1D,     VPOS0760
     2               PHI2D,LCB1(4),LCB2(4),IHIT,AJMTX(3,3),BMTX(3,3),     VPOS0770
     3               SFRX(4),SFRY(4),SFRZ(4),T1PSI,T2PSI,XMUGI(4)         VPOS0780
      LOGICAL LCB1,LCB2                                                    VPOS0790
      COMMON/ADTNL/ U1,U2,U3,U4,V1,V2,V3,V4,W1,W2,W3,W4,                  VPOS0800
     1              XIYP,SPHIC,CPHIC,APTCH1,APTCH2,APTCH3,APTCH4,         VPOS0810
     2              SLOPE1,SLOPE2,XTRA(300)                                VPOS0820
      DIMENSION UI(4),VI(4),WI(4)                                          VPOS0830
      EQUIVALENCE (UI(1),U1),(VI(1),V1),(WI(1),W1)                         VPOS0840
      DIMENSION APITCH(4)                                                  VPOS0850
      EQUIVALENCE (APITCH(1),APTCH1)                                       VPOS0860
      COMMON /INSUS/ XIF,RHOF,TSF,PHIFO,PHIFOD,DEL40,DEL40D,ISUS,         VPOS0870
     1               AKDS,AKDS1,AKDS2,AKDS3,PHIRC(50),DTHF(50),DTHR(50),VPOS0880
     2               NCAMF,NCAMR,NDTHF,NDTHR                               VPOS0890
      COMMON /SUSCMP/ XMURO2,BXMRO2,XMTRO4,ZFO,TSFO2,RHOF2,RHFMUF,        VPOS0900
     1                RHF2MF,RF2MFI,RTF,RRTR,D3PD4,D3MD4,D43,DD3P4,       VPOS0910
     2                DD3M4,ZFD1RF,ZRD34,RFPF,RPF2M,WFMF,PHFP,PHIF2,      VPOS0920
     3                PHIFD2,RPHFD,ZFD1,ZFD2,ZRD4,TPF,SLOPE3,SLOPE4,      VPOS0930
     4                PHI3D,PHI4D,DTHF1,DTHF2,DTHR3,DTHR4,DTDD1,          VPOS0940
     5                DTDD2,DTDD3,DTDD4,FJF(4),SNPF                        VPOS0950
    1 TI(1) = 0.0                                                          VPOS0960
      IF(NTBL2.NE.0) CALL INTRPL(TQF,TB,TE,TINCR,T,TI(1))                  VPOS0970
      TI(2) = TI(1)                                                        VPOS0980
      TI(3) = 0.0                                                          VPOS0990
      IF(NTBL3.NE.0) CALL INTRPL(TQR,TB,TE,TINCR,T,TI(3))                  VPOS1000
```

```
      TI(4) = TI(3)
C
      IS1 = ISUS+1
C
C  LONGITUDINAL WHEEL CENTER VELOCITIES
C
      GO TO (10,11,12),IS1
C
C  SUSPENSION OPTION 0, INDEPENDENT FRONT AND SOLID AXLE REAR
C
   10 IF(NDTHF.EQ.0) GO TO 101
      CALL INTRPC(DTHF,DELB,DELE,DDEL,DEL1,DTHF1,DTDD1)
      CALL INTRPC(DTHF,DELB,DELE,DDEL,DEL2,DTHF2,DTDD2)
  101 U1 = U-(TFO2+DTHF1)*R+ZFD1*Q
      U2 = U+(TFO2+DTHF2)*R+ZFD2*Q
      U3 = U-(TRO2-RPR)*R+(ZRD3R+TPR)*Q
      U4 = U+(TRO2+RPR)*R+(ZRD3R-TPR)*Q
      GO TO 13
C
C  SUSPENSION OPTION 1, INDEPENDENT FRONT AND REAR
C
   11 IF(NDTHF.EQ.0) GO TO 111
      CALL INTRPC(DTHF,DELB,DELE,DDEL,DEL1,DTHF1,DTDD1)
      CALL INTRPC(DTHF,DELB,DELE,DDEL,DEL2,DTHF2,DTDD2)
  111 IF(NDTHR.EQ.0) GO TO 112
      CALL INTRPC(DTHR,DELB,DELE,DDEL,DEL3,DTHR3,DTDD3)
      CALL INTRPC(DTHR,DELB,DELE,DDEL,DEL4,DTHR4,DTDD4)
  112 U1 = U-(TFO2+DTHF1)*R+ZFD1*Q
      U2 = U+(TFO2+DTHF2)*R+ZFD2*Q
      U3 = U-(TRO2+DTHR3)*R + ZRD3*Q
      U4 = U+(TRO2+DTHR4)*R + ZRD4*Q
      GO TO 13
C
C  SUSPENSION OPTION 2, SOLID FRONT AND REAR AXLES
C
   12 U1 = U-(TFO2-RFPF)*R+(ZFD1RF+TPF)*Q
      U2 = U+(TFO2+RFPF)*R+(ZFD1RF-TPF)*Q
      U3 = U-(TRO2-RPR)*R +(ZRD3R+TPR)*Q
      U4 = U+(TRO2+RPR)*R +(ZRD3R-TPR)*Q
   13 CONTINUE
      SFYU = 0.0
      SFXU = 0.0
      SFYUF = 0.0
      SFYUR = 0.0
C             SFYUF AND SFYUR NO LONGER USED
      SFZU = 0.0
    2 AMTX(1,1) = COSTH*COSPS
      AMTX(2,1) = COSTH*SINPS
      AMTX(3,1) = -SINTH
      AMTX(1,2) = -COSPH*SINPS+SINPH*SINTH*COSPS
      AMTX(2,2) = COSPH*COSPS+SINPH*SINTH*SINPS
```

```
      AMTX(3,2) = COSTH*SINPH
      AMTX(1,3) = SINPH*SINPS+COSPH*SINTH*COSPS
      AMTX(2,3) = -COSPS*SINPH+COSPH*SINTH*SINPS
      AMTX(3,3) = COSTH*COSPH
      CAY = AMTX(1,2)
      CBY = AMTX(2,2)
      CGY = AMTX(3,2)
      CAX = AMTX(1,1)
      CBX = AMTX(2,1)
      CGX = AMTX(3,1)
C
      IF(ISUS.EQ.2) GO TO 21
      YTMP = TFO2+DTHF1
      ZTMP = ZFD1
      GO TO 31
   21 YTMP = TFO2-RFPF
      ZTMP = ZFO+DEL1+TPF
   31 X1P = XCP+AMTX(1,1)*A+AMTX(1,2)*YTMP+AMTX(1,3)*ZTMP
      Y1P = YCP+AMTX(2,1)*A+AMTX(2,2)*YTMP+AMTX(2,3)*ZTMP
      Z1P = ZCP+AMTX(3,1)*A+AMTX(3,2)*YTMP+AMTX(3,3)*ZTMP
      IF(ISUS.EQ.2) GO TO 22
      YTMP = -TFO2-DTHF2
      ZTMP = ZFD2
      GO TO 32
   22 YTMP = -TFO2-RFPF
      ZTMP = ZFO+DEL2-TPF
   32 X2P = XCP+AMTX(1,1)*A+AMTX(1,2)*YTMP+AMTX(1,3)*ZTMP
      Y2P = YCP+AMTX(2,1)*A+AMTX(2,2)*YTMP+AMTX(2,3)*ZTMP
      Z2P = ZCP+AMTX(3,1)*A+AMTX(3,2)*YTMP+AMTX(3,3)*ZTMP
      IF(ISUS.EQ.1) GO TO 23
      YTMP = TRO2-RPR
      ZTMP = ZRO+DEL3+TPR
      GO TO 33
   23 YTMP = TRO2+DTHR3
      ZTMP = ZRD3
   33 X3P = XCP-AMTX(1,1)*B+AMTX(1,2)*YTMP+AMTX(1,3)*ZTMP
      Y3P = YCP-AMTX(2,1)*B+AMTX(2,2)*YTMP+AMTX(2,3)*ZTMP
      Z3P = ZCP-AMTX(3,1)*B+AMTX(3,2)*YTMP+AMTX(3,3)*ZTMP
      IF(ISUS.EQ.1) GO TO 24
      YTMP = -TRO2-RPR
      ZTMP = ZRO+DEL3-TPR
      GO TO 34
   24 YTMP = -TRO2-DTHR4
      ZTMP = ZRD4
   34 X4P = XCP-AMTX(1,1)*B+AMTX(1,2)*YTMP+AMTX(1,3)*ZTMP
      Y4P = YCP-AMTX(2,1)*B+AMTX(2,2)*YTMP+AMTX(2,3)*ZTMP
      Z4P = ZCP-AMTX(3,1)*B+AMTX(3,2)*YTMP+AMTX(3,3)*ZTMP
C
C     QUADRATIC INTERPOLATION SUBROUTINE INTRPL,ADDITIONAL ENTRY INTRPC
C
C
```

```
      IF(ISUS.EQ.2) GO TO 50
      CALL INTRPC(PHIC,DELB,DELE,DDEL,DEL1,PHI1,SLOPE1)
      PHI1 = PHI1*RAD
      SLOPE1 = SLOPE1*RAD
      PHI1D = SLOPE1*DEL1D
      CALL INTRPC(PHIC,DELB,DELE,DDEL,DEL2,PHI2,SLOPE2)
      PHI2 = -PHI2*RAD
      SLOPE2 = -SLOPE2*RAD
      PHI2D = SLOPE2*DEL2D
      GO TO 51
   50 PHI1 = PHIF
      PHI2 = PHIF
      PHI1D = PHIFD
      PHI2D = PHIFD
   51 IF(ISUS.EQ.1) GO TO 52
      PHI3 = PHIR
      PHI4 = PHIR
      PHI3D = PHIRD
      PHI4D = PHIRD
      GO TO 53
   52 CALL INTRPC(PHIRC,DELB,DELE,DDEL,DEL3,PHI3,SLOPE3)
      PHI3 = PHI3*RAD
      SLOPE3 = SLOPE3*RAD
      PHI3D = SLOPE3*DEL3D
      CALL INTRPC(PHIRC,DELB,DELE,DDEL,DEL4,PHI4,SLOPE4)
      PHI4 = -PHI4*RAD
      SLOPE4 = -SLOPE4*RAD
      PHI4D = SLOPE4*DEL4D
   53 CONTINUE
C
   40 IF(INDCRB.EQ.0) GO TO 5
      IF(IHIT.EQ.1.OR.INDCRB.LT.0) GO TO 6
    5 CALL DRIVER(PSICON,PSISLP,J)
      IF(J.NE.0) GO TO 5001
      PSICON = 0.0
      PSISLP = 0.0
      IF(NTBL1.NE.0) CALL INTRPC(PSIF,TB,TE,TINCR,T,PSICON,PSISLP)
      PSICON = PSICON*RAD
      PSISLP=PSISLP*RAD
 5001 CONTINUE
C     FORMERLY PSIFP=PSI1,NO LONGER USED.FORMERLY PSIFID=(PSI1-PSIFP)/DT
      PSI1 = PSICON
      PSIFID = PSISLP
      PSIFI = PSI1
      GO TO 7
    6 PSI1 = PSIFI
    7 PSI2 = PSI1
C
      IF(ISUS.EQ.1) GO TO 54
      PSI3 = AKRS*PHIR
      PSI4 = PSI3
```

```
      RETURN                                                    VPOS2540
   54 PSI3 = AKDS+AKDS1*DEL3+AKDS2*DEL3**2+AKDS3*DEL3**3        VPOS2550
      PSI4 = -(AKDS+AKDS1*DEL4+AKDS2*DEL4**2+AKDS3*DEL4**3)     VPOS2560
      RETURN                                                    VPOS2570
      END                                                       VPOS2580
```

```
      SUBROUTINE WHEEL(/AKT/,/SIGT/,/XLAMT/,/RWHJB/,/RWHJE/,/DRWHJ/,
     1 /NFJP/,/RW/,FJP,/NO/)
C              HVOSM-RD2 VERSION
C              REVISED OCTOBER 1975   CALSPAN CORPORATION
      DIMENSION FJP(50)
    1 DA = 4.0*0.01745
      FJP(1) = 0.0
      N = NFJP
      IF (N.LE.NO) GO TO 3
      PRINT 2,N,NO
2       FORMAT ('ODIM. FOR FJP TOO SMALL,',I6,' NEEDED.', I6,' PROVIDED.
     1 ')
      STOP
3     CONTINUE
      NL = N-1
      DD = (RWHJE-RWHJB)/FLOAT(NL)
      DDK = DD*AKT
      K = 0
      D = 0.0
      DO 10  J=2,N
      FJP(J) = FJP(J-1)+DDK
      D = D+DD
      IF (K.NE.0) GO TO 10
      IF (D.LT.SIGT) GO TO 10
      X = DDK
      DDK = DDK*XLAMT
      FJP(J) = FJP(J)+(DDK-X)*(D-SIGT)/DD
      K = 1
   10 CONTINUE
   15 R = RW
      DO 19  J=2,N
      B = 1.0
      DDK = DD/R
      Z=DDK
  200 ANG = 0.0
      F = Z*B
  201 ANG = ANG+DA
      Y=1-Z
      X = COS(ANG)
      IF(X.LE.Y) GO TO 16
      F = F+2.0*(X-Y)*B
      GO TO 201
   16 B = FJP(J)/F
      FJP(J) = DDK*B
      IF (J.EQ.N) GO TO 1901
      I=J+1
      DO 18  L=I,N
      Z=Z+DDK
  300 ANG = 0.0
```

```
      F = Z*B
  301 ANG = ANG+DA
      Y=1-Z
      X = COS(ANG)
      IF(X.LE.Y) GO TO 18
      F = F+2.0*(X-Y)*B
      GO TO 301
   18 FJP(L) = FJP(L)-F
   19 R = R-DD
 1901 DD =0.0
      DO 20 J=2,N
      DD=DD+FJP(J)
20    FJP(J)=FJP(J-1)+DD
      RETURN
      END
```

3.2 Vehicle Dynamics Version

A description of each computational subroutine of the HVOSM-VD2 is provided in this section. Included is a brief description of the purpose of the subroutine, a description of the linkages to the rest of the program in the forms of subroutines called, calling arguments, common blocks appearing, variables within the common blocks that are the result of a computation, and, the subroutine size. Also included is a description of the computational procedure employed either in the form of a verbal listing of the computational steps or an annotated flowchart illustrating the logical sequence of computations. Since this part of the subroutine description is intended to illustrate the procedure, it does not always illustrate each individual line of coding. When a detailed investigation of the coding is required, the computational procedure should be used in conjunction with a subroutine listing.

An overall program block diagram is shown in Figure 3.2-1, a matrix of common blocks appearing in each subroutine in Figure 3.2-2, and a matrix of subroutine calls in Figure 3.2-3.

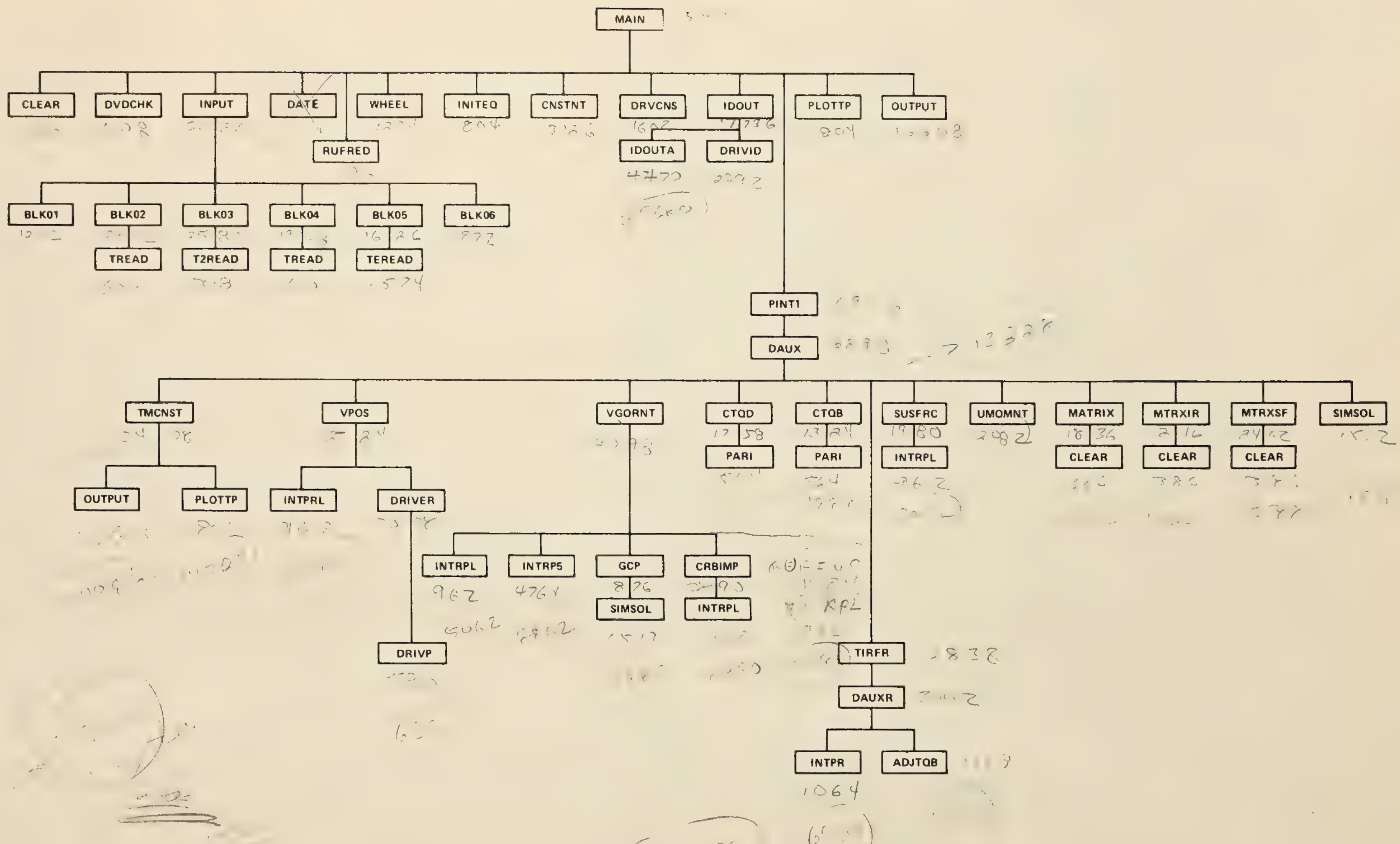


Figure 3.2-1 HVOSM-VD2 OVERALL PROGRAM BLOCK DIAGRAM

COMMON BLOCK

	HEAD	INPT	INPT1	INTG	DIMV	COMP	COMPN	EINDEX	ADTNL	INPT3	APTABL	TIRIN	INPT4	COMP4	INPT5	COMP5	INTR	INSUS	SUSCMP	DRIVTT	DRIVI	DRIVE	NEWCRB	RUFNES
MAIN	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●
ADJTQB					●										●	●	●							
BLKO1	●	●	●										●					●		●			●	
BLKO2	●	●	●							●	●		●		●			●						
BLKO3	●		●									●	●											
BLKO4	●	●													●						●	●		
BLKO5	●	●	●																				●	●
BLKO6	●	●	●												●			●						
CLEAR																								
CNSTNT	●	●	●	●		●	●	●				●	●	●	●	●	●	●	●				●	
CRBIMP			●	●	●	●	●					●											●	
CTQB															●	●								
CTQD				●									●		●	●	●			●	●	●		
DATE																								
DAUX		●	●	●	●	●	●		●				●	●			●	●	●					
DAUXR					●		●					●	●	●	●	●	●							
DRIVER			●	●	●	●		●												●	●	●		
DRIVID	●	●																		●	●	●		
DRIVP																				●	●	●		
DRVCNS		●	●		●	●	●						●		●	●	●			●	●	●		
DVDCHK																								
GCP					●	●						●												
IDOUT	●	●	●			●				●	●	●	●					●		●			●	
IDOUTA	●												●		●									
INITEQ		●			●	●	●					●						●						
INPUT																								
INTPR																								
INTRPL																								
INTRP5		●			●	●	●					●												
MATRIX		●		●	●	●			●															
MTRXIR		●		●	●	●			●										●					
MTRXSF		●		●	●	●			●									●	●					
OUTPUT	●	●		●	●	●	●		●				●	●		●	●	●	●			●		
PARI																								
PINT1																								
PLOTTP		●		●	●	●	●					●												
RUFFRC			●		●	●	●					●												●
RUFRED																								
SIMSOL																								
SUSFRC		●		●	●	●			●	●	●							●	●					
TEREAD		●																						
TIRFR		●		●	●	●	●						●	●	●	●	●							
TMCNST		●		●		●		●						●	●			●	●					
TREAD																								
T2READ																								
UMOMNT		●			●	●										●		●	●					
VPOS		●	●	●	●	●	●		●									●	●					
VGORNT		●	●	●	●	●	●		●			●						●	●				●	●
WHEEL																								

Figure 3.2-2 HVOSM-VD2 COMMON BLOCK ALLOCATIONS

CALLED ROUTINE

CALLING ROUTINE	MAIN	ADJTQB	BLKO1	BLKO2	BLKO3	BLKO4	BLKO5	BLKO6	CLEAR	CNSTNT	CRBIMP	CTQB	CTQD	DATE	DAUX	DAUXR	DRIVER	DRIVID	DRIVP	DRVCNS	DVDCHK	GCP	IDOUT	IDOUTA	INITEQ	INPUT	INTPR	INTRPL	INTRP5	MATRIX	MTRXIR	MTRXSF	OUTPUT	PARI	PINT1	PLOTTP	RUFFRC	RUFRED	SIMSOL	SUSFRC	TEREAD	TIRFR	TMCNST	TREAD	T2READ	UMOMNT	VPOS	VGORNT	WHEEL
MAIN									●	●				●						●	●		●		●	●							●		●	●		●											●
ADJTQB																																																	
BLKO1																																																	
BLKO2																																												●					
BLKO3																																													●				
BLKO4																																												●					
BLKO5																																									●								
BLKO6																																																	
CLEAR																																																	
CNSTNT																																																	
CRBIMP																												●																					
CTQB																																		●															
CTQD																																		●															
DATE																																																	
DAUX												●	●																	●	●	●							●	●		●	●			●	●	●	
DAUXR		●																									●																						
DRIVER																			●																														
DRIVID																																																	
DRIVP																																																	
DRVCNS																																																	
DVDCHK																																																	
GCP																																							●										
IDOUT																		●						●																									
IDOUTA																																																	
INITEQ																																																	
INPUT			●	●	●	●	●	●																																									
INTPR																																																	
INTRPL																																																	
INTRP5																																																	
MATRIX									●																																								
MTRXIR									●																																								
MTRXSF									●																																								
OUTPUT																																																	
PARI																																																	
PINT1															●																																		
PLOTTP																																																	
RUFFRC																												●																					
RUFRED																																																	
SIMSOL																																																	
SUSFRC																												●																					
TEREAD																																																	
TIRFR																●																																	
TMCNST																																	●			●													
TREAD																																																	
T2READ																																																	
UMOMNT																																																	
VPOS																	●											●																					
VGORNT											●											●						●	●								●												
WHEEL																																																	

Figure 3.2-3 HVOSM-VD2 MATRIX OF SUBROUTINE CALLS

3.2.1 HVOSM-VD2 Subroutine Documentation

1. MAIN ROUTINE

a. Purpose:

1. Clear selected COMMON blocks
2. Obtain input and print input
3. Program initialization
4. Control computation of constants
5. Control the integration loop
6. Control abnormal program stops
7. Control indexing of coordinate system
8. Control integration step size for curb
9. Control output

b. Common Blocks Required:

HEAD, INPT, INPT1, INTG, DIMV, COMP, COMPN, EINDEX, ADTNL, INPT3, APTBL, DRIVTT, DRIVI, DRIVE, COMP4, COMP5, INPT4, INPT5, INTR, TIRIN, INSUS, SUSCMP, NEWCRB, RUFNES

c. Subroutines Required:

CLEAR, DVDCHK, INPUT, DATE, IDOUT, CNSTNT, PLOTTP, PINT1, OUTPUT, WHEEL, RUFRED, INITEQ, DRVCNS

d. Arguments:

None

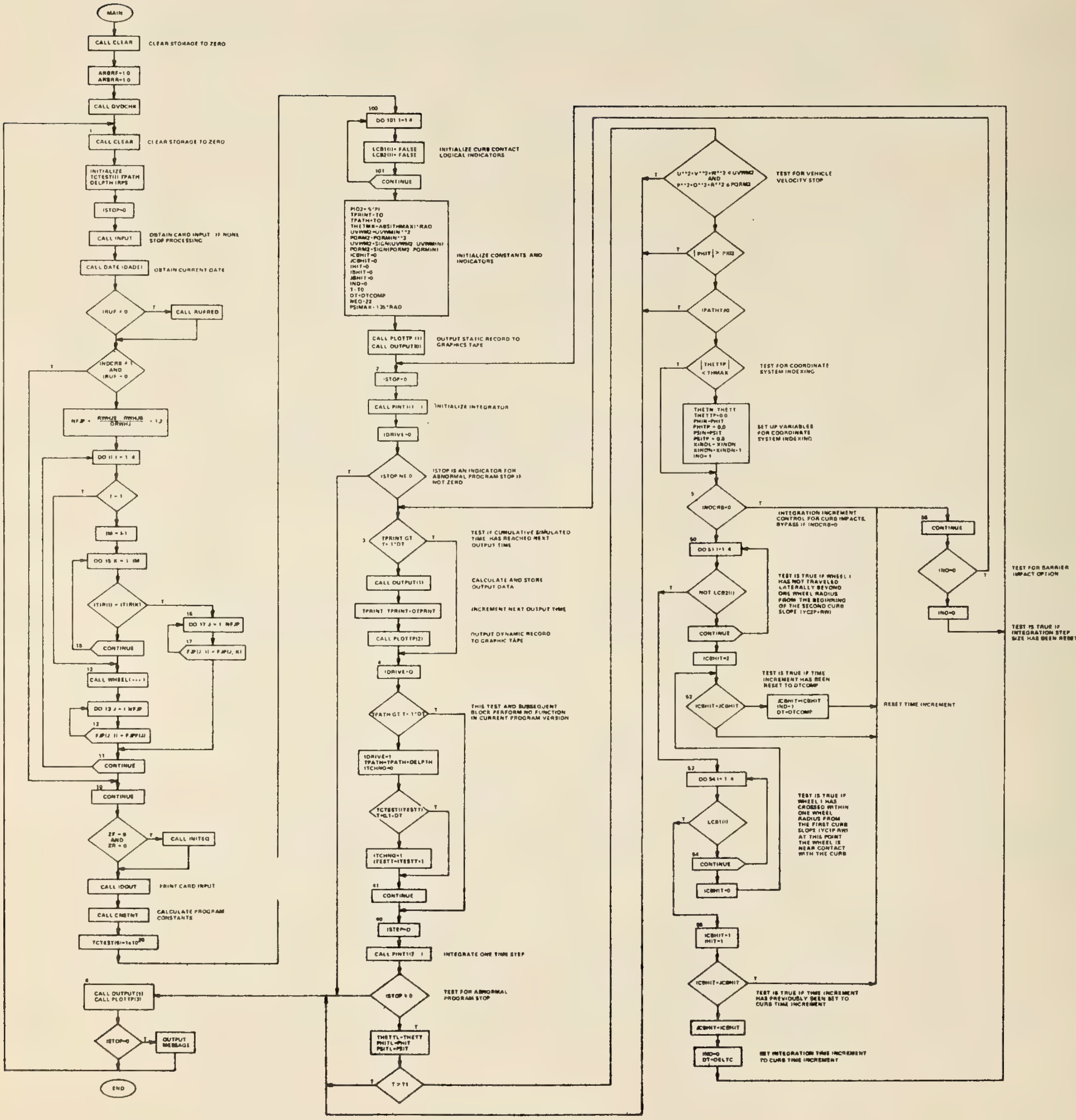
e. Common Variables Calculated:

DT, FJP, NEQ, ZGP, DADE, IHIT, IRPS, LCB1, LCB2, PHIN, PSIN, ISTEP, ISTOP, PHIB1, PHIB2, PHITL, PHITP, PSITL, PSITP, TPATH, XINDL, XINDN, DELPTH, ICBHIT, IDRIVE, ITCHNG, ITESTT, JCBHIT, PQRMIN, TCTEST, THETTL, THETTP

f. Size:

$D92)_{16} = 3474)_{10}$ bytes

g. Computational Procedure:



MAIN
CALL CLEAR
CLEAR STORAGE TO ZERO
CALL DVDCHK
INITIALIZE TCTEST(I) TPATH DELPTH IRPS
ISTOP=0
CALL INPUT
OBTAIN CARD INPUT IF NONE STOP PROCESSING
CALL DATE (DADE)
OBTAIN CURRENT DATE
CALL RUFRED
CONTINUE
CALL INITEQ
CALL IDOUT
PRINT CARD INPUT
CALL CRETRT
CALCULATE PROGRAM CONSTANTS
CALL OUTPUT(3)
CALL PLOTTP(3)
OUTPUT MESSAGE
END
INITIALIZE CURB CONTACT LOGICAL INDICATORS
INITIALIZE CONSTANTS AND INDICATORS
OUTPUT STATIC RECORD TO GRAPHICS TAPE
INITIALIZE INTEGRATOR
ISTOP IS AN INDICATOR FOR ABNORMAL PROGRAM STOP IF NOT ZERO
TEST IF CUMULATIVE SIMULATED TIME HAS REACHED NEXT OUTPUT TIME
CALL OUTPUT(1)
CALCULATE AND STORE OUTPUT DATA
INCREMENT NEXT OUTPUT TIME
OUTPUT DYNAMIC RECORD TO GRAPHIC TAPE
THIS TEST AND SUBSEQUENT BLOCK PERFORM NO FUNCTION IN CURRENT PROGRAM VERSION
INTEGRATE ONE TIME STEP
TEST FOR ABNORMAL PROGRAM STOP
T > T1
TEST FOR VEHICLE VELOCITY STOP
TEST FOR COORDINATE SYSTEM INDEXING
SET UP VARIABLES FOR COORDINATE SYSTEM INDEXING
INTEGRATION INCREMENT CONTROL FOR CURB IMPACTS, BYPASS IF INDCRB=0
TEST FOR BARRIER IMPACT OPTION
TEST IS TRUE IF INTEGRATION STEP SIZE HAS BEEN RESET
TEST IS TRUE IF TIME INCREMENT HAS BEEN RESET TO DTCOMP
RESET TIME INCREMENT
TEST IS TRUE IF THIS INCREMENT HAS PREVIOUSLY BEEN SET TO CURB TIME INCREMENT
SET INTEGRATION TIME INCREMENT TO CURB TIME INCREMENT

2. SUBROUTINE ADJTQB

a. Purpose:

1. To adjust braking torques at low values of wheel rotational velocity to prevent sign reversal

b. Common Blocks Required:

DIMV, INTR, INPT5, COMP5

c. Subroutines Required:

None

d. Arguments:

None

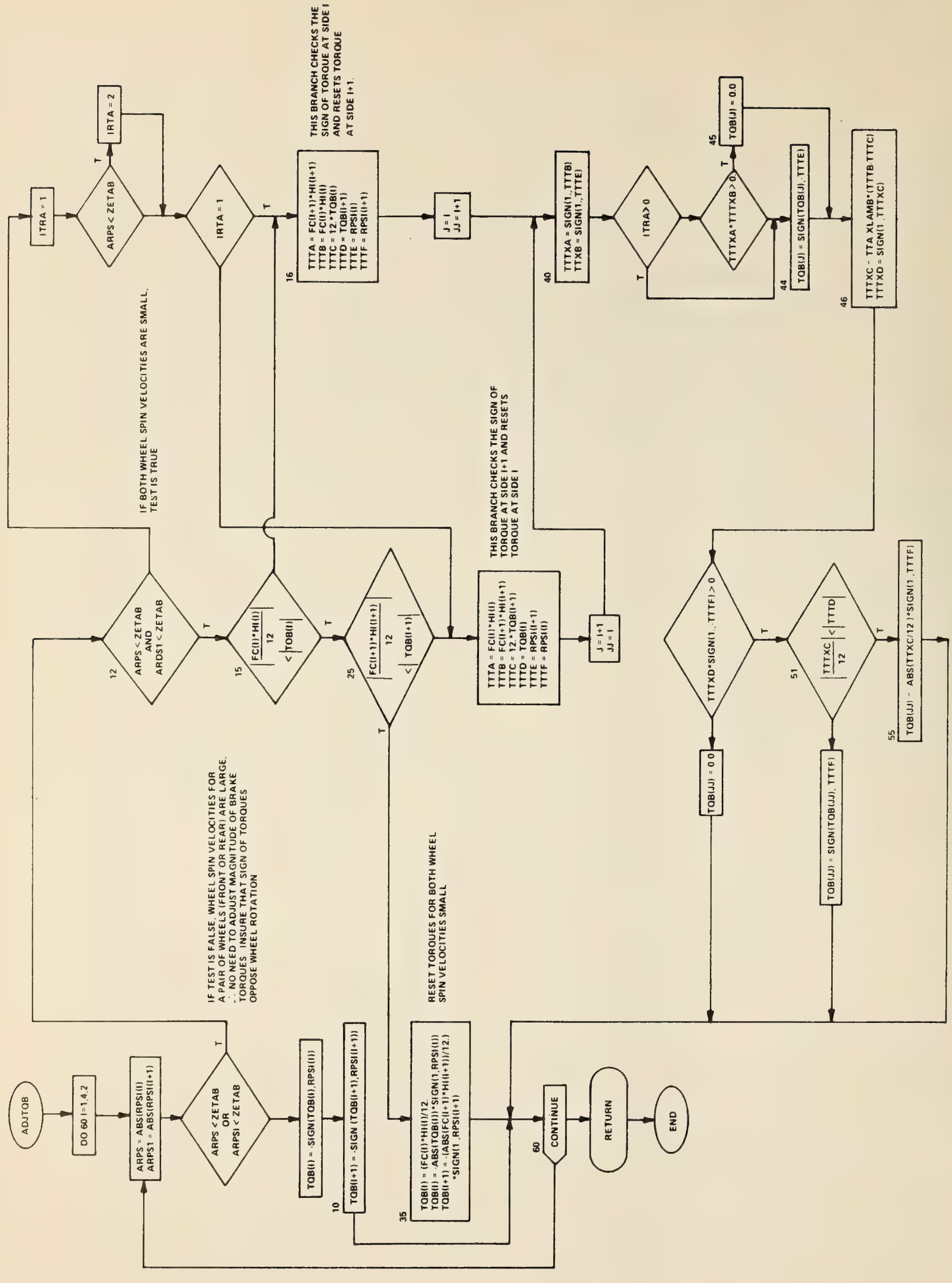
e. Common Variables Calculated:

TQB

f. Size:

$45E)_{16} = 1118)_{10}$ bytes

g. Computational Procedure:


ADJTQB
DO 60 I=1,4,2
ARPS = ABS(RPSI(I))
ARPS1 = ABS(RPSI(I+1))
ARPS < ZETAB OR ARPSI < ZETAB
TQB(I) = -SIGN(TQB(I),RPSI(I))
TQB(I+1) = -SIGN (TQB(I+1),RPSI(I+1))
TQB(I) = (FC(I)*HI(I))/12.
TQB(I) = -ABS(TQB(I))*SIGN(1.,RPSI(I))
TQB(I+1) = -(ABS(FC(I+1)*HI(I+1))/12.)
*SIGN(1.,RPSI(I+1))
CONTINUE
RETURN
END
IF TEST IS FALSE, WHEEL SPIN VELOCITIES FOR A PAIR OF WHEELS (FRONT OR REAR) ARE LARGE, ∴ NO NEED TO ADJUST MAGNITUDE OF BRAKE TORQUES. INSURE THAT SIGN OF TORQUES OPPOSE WHEEL ROTATION
RESET TORQUES FOR BOTH WHEEL SPIN VELOCITIES SMALL
ARPS < ZETAB AND ARPS1 < ZETAB
IF BOTH WHEEL SPIN VELOCITIES ARE SMALL, TEST IS TRUE
ITRA = 1
ARPS < ZETAB
IRTA = 2
IRTA = 1
TTTA = FC(I+1)*HI(I+1)
TTTB = FC(I)*HI(I)
TTTC = 12.*TQB(I)
TTTD = TQB(I+1)
TTTE = RPSI(I)
TTTF = RPSI(I+1)
THIS BRANCH CHECKS THE SIGN OF TORQUE AT SIDE I AND RESETS TORQUE AT SIDE I+1.
TTTA = FC(I)*HI(I)
TTTB = FC(I+1)*HI(I+1)
TTTC = 12.*TQB(I+1)
TTTD = TQB(I)
TTTE = RPSI(I+1)
TTTF = RPSI(I)
THIS BRANCH CHECKS THE SIGN OF TORQUE AT SIDE I+1 AND RESETS TORQUE AT SIDE I
J = I
JJ = I+1
J = I+1
JJ = I
TTTXA = SIGN(1.,TTTB)
TTXB = SIGN(1.,TTTE)
ITRA > 0
TTTXA*TTTXB > 0
TQB(J) = 0.0
TQB(J) = SIGN(TQB(J),TTTE)
TTTXC = TTA XLAMB*(TTTB-TTTC)
TTTXD = SIGN(1.,TTTXC)
TTTXD*SIGN(1.,TTTF) > 0
TQB(JJ) = 0.0
TQB(JJ) = SIGN(TQB(JJ),TTTF)
TQB(JJ) = ABS(TTXC/12.)*SIGN(1.,TTTF)
10
12
15
16
25
35
40
44
45
46
51
55
60
T

3. SUBROUTINE BLK01

a. Purpose:

1. Assign input values of simulation control data

b. Common Blocks Required:

HEAD, INPT, INPT1, INPT4, INSUS, NEWCRB, DRIVTT

c. Subroutines Required:

None

d. Arguments:

NBLK - Input data block number
NBCRD - Card number within the block
NSEQ - Table sequence number
NCARD - Card number
DUM - Array containing input values read in Subroutine INPUT to be assigned to the appropriate variable names within this subroutine
NERR - Error indicator

e. Common Variables Calculated:

EM, T0, T1, AAA, BET, HED, EBAR, HMAX, HMIN, IBUG, ISUS, MODE, NERR, DELTC, NPAGE, DTCOMP, DTPRNT, IDRVER, INDCRB, NCRBSL, PQRMIN

f. $4DA)_{16} = 1242)_{10}$ bytes

4. SUBROUTINE BLK02

a. Purpose:

1. Assign input values of simulation vehicle data

b. Common Blocks Required:

HEAD, INPT, INPT1, INPT3, APTABL, INSUS, INPT4, INPT5

c. Subroutines Required:

TREAD

d. Arguments:

NBLK - Input data block number
NBCRD - Card number within the block
NSEQ - Table sequence number
NCARD - Card number
DUM - Array containing input values read in Subroutine INPUT to be assigned to the appropriate variable names within this subroutine
NERR - Error indicator

e. Common Variables Calculated:

A, B, G, CF, CR, GN, RF, RR, TF, TR, TS, X1, X2, Y1, Y2, ZF, ZR, Z1, Z2, AKF, AKR, AK1, AK2, APF, APR, CFP, CRP, RHO, TCT, TLF, TSF, XIF, XIR, XIX, XIY, XIZ, XMS, XPS, AKDS, AKFC, AKFE, AKPS, AKRC, AKRE, AKRS, BRPM, BTLF, CONE, CPSP, CTWO, DDEL, DELB, DELE, DRPM, DTHF, DTHR, DTLF, EPSF, EPSR, ERPM, ETLF, NAPF, NAPR, NDEL, NRPM, NTLF, PHIC, PONE, PTWO, RHOF, TWOT, VHED, XIPS, XIXZ, XMUF, XMUR, AKDS1, AKDS2, AKDS3, AKFCP, AKFEP, AKRCP, AKREP, ARBRF, ARBRR, DAPFB, DAPFE, DAPRB, DAPRE, DDAPF, DDAPR, EPSPS, FIDJF, FIDJR, FIWJF, FIWJR, IAPFR, IBTYP, NDTHF, NDTHR, NPAGE, PZERO, XLAMF, XLAMR, ZETAB, CTHREE, OMEGFC, OMEGFE, OMEGRC, OMEGRE

f. Size:

$B38)_{16} = 2872)_{10}$ bytes

5. SUBROUTINE BLK03

a. Purpose:

1. Assign input values of simulation tire data

b. Common Blocks Required:

HEAD, INPT1, TIRIN, INPT4

c. Subroutines Required:

T2READ

d. Arguments:

NBLK - Input data block number
NBCRD - Card number within the block
NSEQ - Table sequence number
NCARD - Card number
DUM - Array containing input values read in Subroutine INPUT to be assigned to the appropriate variable names within this subroutine
NERR - Error indicator

e. Common Variables Calculated:

A0, A1, A2, A3, A4, CT, RW, AKT, AMU, ITIR, RRMC, SIGT, THED, XMUM, DRWHJ, OMEGT, RWHJE, XLAMT, NXFRCP, NXUGMU, XMUMAT, XMXPMT, XMXSMT, XXFRPD, XXUGMU

f. Size:

$A16)_{16} = 2582)_{10}$ bytes

6. SUBROUTINE BLK04

a. Purpose:

1. Assign input values of vehicle control data

b. Common Blocks Required:

HEAD, INPT, INPT5, DRIVI, DRIVE

c. Subroutines Required:

TREAD

d. Arguments:

NBLK - Input data block number
NBCRD - Card number within the block
NSEQ - Table sequence number
NCARD - Card number
DUM - Array containing input values read in Subroutine INPUT to be assigned to the appropriate variable names within this subroutine
NERR - Error indicator

e. Common Variables Calculated:

S, DS, EN, TB, TE, TL, BTT, DTT, ETT, TIL, TPC, TTR, TTS, BFP1, BFP2, CHED, EMDT, FKD0, NTTS, NTT1, NTT2, NTT3, TAUF, DESSI, DISTI, FKS10, FKS20, GEAR1, GEAR2, GEAR3, GEAR4, NPAGE, NTBL1, NTRAN, TINCR, VGR12, VGR21, VGR23, VGR32, VGR34, VGR43, APDMAX, FKSKD0, TESTB0, TSTR10, TSTR20, TSTS10, TSTS20, XIMPOR, YTRANS

f. Size:

$788)_{16} = 1928)_{10}$ bytes

7. SUBROUTINE BLK05

a. Purpose:

1. Assign input values of terrain and curb data

b. Common Blocks Required:

HEAD, INPT, INPT1, NEWCRB

c. Subroutines Required:

TEREAD

d. Arguments:

NBLK - Input data block number
NBCRD - Card number within the block
NSEQ - Table sequence number
NCARD - Card number
DUM - Array containing input values read in Subroutine INPUT to be assigned to the appropriate variable names within this subroutine
NERR - Error indicator

e. Common Variables Calculated:

NX, NY, XB, XE, YB, YE, NBX, NBY, NZ5, AMUG, DELG, GHED, IRUF, NEND, YC1P, YC2P, YC3P, YC4P, YC5P, YC6P, ZC2P, ZC3P, ZC4P, ZC5P, ZC6P, DGMAX, NPAGE, NZTAB, PHIC1, PHIC2, PHIC3, PHIC4, PHIC5, PHIC6, XINCR, YINCR

f. Size:

$65A)_{16} = 1626)_{10}$ bytes

8. SUBROUTINE BLK06

a. Purpose:

1. Assign input values of simulation initial conditions

b. Common Blocks Required:

HEAD, INPT, INPT1, INSUS, INPT5

c. Subroutines Required:

None

d. Arguments:

NBLK - Input data block number
NBCRD - Card number within the block
NSEQ - Table sequence number
NCARD - Card number
DUM - Array containing input values read in Subroutine INPUT to be assigned to the appropriate variable names within this subroutine
NERR - Error indicator

e. Common Variables Calculated:

P0, Q0, R0, U0, V0, W0, PHI0, PSI0, SHED, TAUA, TAU0, XCOP, YCOP, ZCOP, DEL10, DEL20, DEL30, DEL40, PHIF0, PHIR0, DEL10D, DEL20D, DEL30D, DEL40D, PHIF0D, PHIR0D, PSIFD0, PSIFI0, THETA0

f. Size:

$368)_{16} = 872)_{10}$ bytes

9. SUBROUTINE CLEAR(A,B)

a. Purpose:

1. To set a block of storage to zero

b. Common Blocks Required:

None

c. Subroutines Required:

None

d. Arguments:

A - beginning address to be cleared
B - end of the full-word address to be cleared

e. Common Variables Calculated:

None

f. Size:

$182)_{16} = 386)_{10}$ bytes

10. SUBROUTINE CNSTNT

a. Purpose:

1. Evaluate program constants
2. Initialize dependent variables and derivatives to input initial conditions

b. Common Blocks Required:

HEAD, INPT, INPT1, INTG, COMP, COMPN, EINDEX, TIRIN, COMP4, COMP5, INPT4, INPT5, INTR, INSUS, SUSCMP, NEWCRB

c. Subroutines Required:

None

d. Arguments:

None

e. Common Variables Calculated:

P, Q, R, U, V, W, TT, A12, A23, RAD, RTF, RTR, TAU, TIZ, TM4, XCP, YCP, ZCP, ZF0, ZPR, ZR0, AMUF, BMUR, DEL1, DEL2, DEL3, DEL4, GAM1, PHIF, PHIN, PHIR, PI02, PI04, PSIN, RFTF, RH02, RRTR, RRTS, TR02, TS02, XIZR, YCLP, YC3P, YC4P, YC5P, YC6P, ZCLP, ZC3P, ZC4P, ZC5P, ZC6P, ARBRI, DEL1D, DEL2D, DEL3D, DEL4D, JDEND, NPAGE, PHIFD, PHIRD, PHITL, PHITP, PSIFI, PSITL, PSITP, RHMR2, RHOF2, RPSFA, RPSFB, RPSFC, RPSFD, RPSFE, THETN, TLAMB, TRPME, TSF02, TWOPI, XINDN, A02APB, ARFAC1, ARFAC2, ARFAC3, AXMF02, B02APB, BROMUR, BXMR02, OMT2A2, OMT2M1, PHICLR, PHIC1R, PHIC2R, PHIC3R, PHIC4R, PHIC5R, PHIC6R, PI015R, RF2MFI, RHFMUF, RHF2MF, RHMR2I, RHOMUR, TANPC1, TANPC2, TANPC3, TANPC4, TANPC5, TANPC6, TBRAKA, TBRAKB, TBRAKD, THETTL, THETTP, TWOPIR, XMTF04, XMTR04, XMUF02, XMUR02

f. Size:

$C36)_{16} = 3126)_{10}$ bytes

g. Computational Procedure:

1. Compute program constants
2. Initialize dependent variables converting degrees to radians
3. Initialize XINDN = 10, if THETN or PHIN are not zero for use in MAIN and TMCNST to control coordinate system indexing

SUBROUTINE CRBIMP(I)

a. Purpose:

1. Determine the radial tire force and equivalent ground contact point when a tire is in contact with a curb

b. Common Blocks Required:

INPT1, DIMV, COMP, COMPN, INTG, TIRIN, NEWCRB

c. Subroutines Required:

INTRPL

d. Arguments:

The argument I indicates the wheel number for which calculations are made

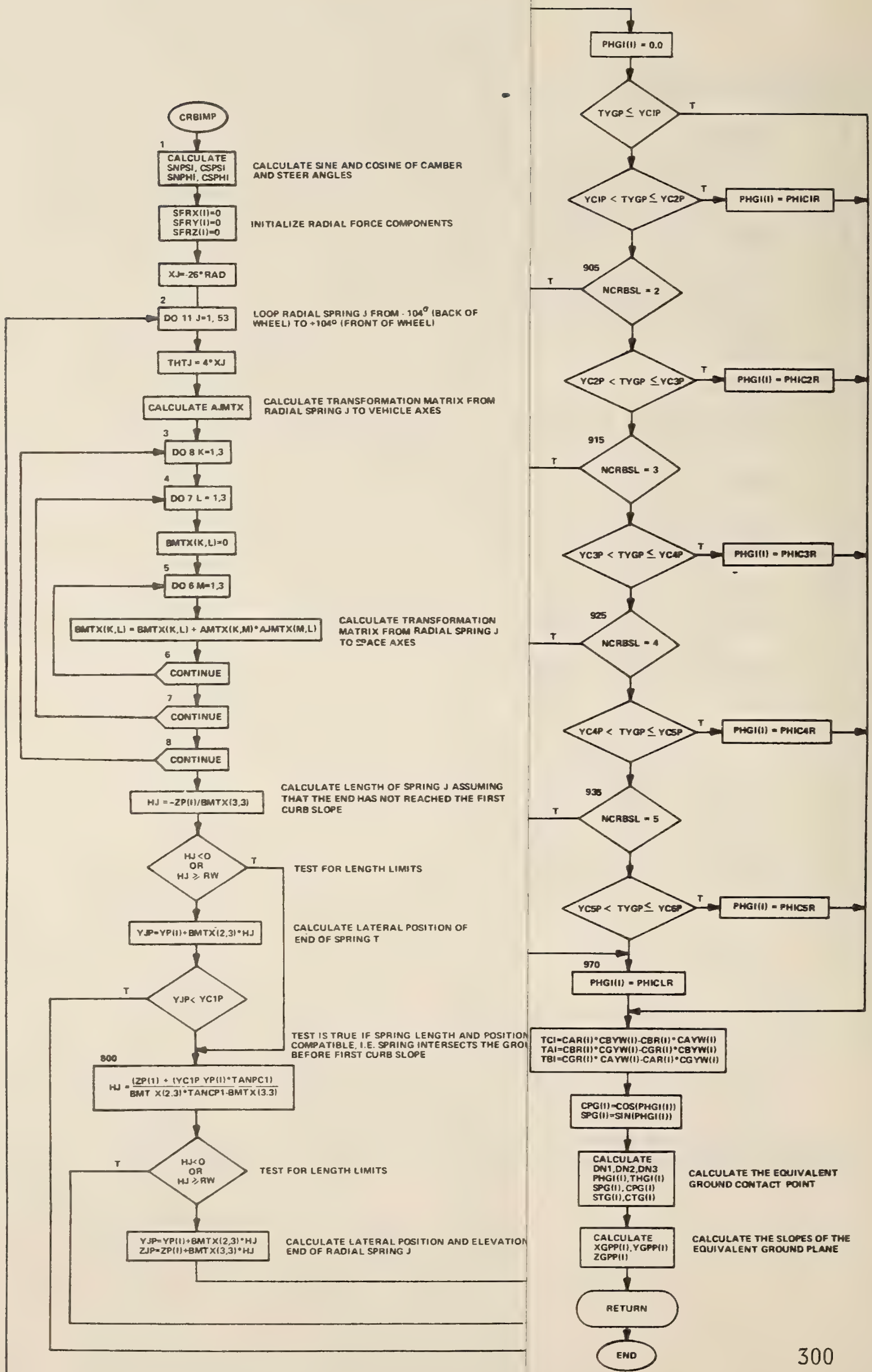
e. Common Variables Calculated:

FR, HI, RW, CAR, CBR, CGR, CPG, CTG, SPG, STG, BMTX, PHGI, SFRX, SFRY, SFRZ, THGI, XGPP, YGPP, ZGPP, AJMTX

f. Size:

$F32)_{16} = 3890)_{10}$ bytes

g. Computational Procedure:


CRBIMP
1
CALCULATE SNPSI, CSPSI SNPHI, CSPHI
CALCULATE SINE AND COSINE OF CAMBER AND STEER ANGLES
SFRX(I)=0
SFRY(I)=0
SFRZ(I)=0
INITIALIZE RADIAL FORCE COMPONENTS
XJ=-26*RAD
2
DO 11 J=1, 53
LOOP RADIAL SPRING J FROM -104° (BACK OF WHEEL) TO +104° (FRONT OF WHEEL)
THTJ = 4*XJ
CALCULATE AJMTX
CALCULATE TRANSFORMATION MATRIX FROM RADIAL SPRING J TO VEHICLE AXES
3
DO 8 K=1,3
4
DO 7 L = 1,3
BMTX(K,L)=0
5
DO 6 M=1,3
BMTX(K,L) = BMTX(K,L) + AMTX(K,M)*AJMTX(M,L)
CALCULATE TRANSFORMATION MATRIX FROM RADIAL SPRING J TO SPACE AXES
6
CONTINUE
7
CONTINUE
8
CONTINUE
HJ = -ZP(I)/BMTX(3,3)
CALCULATE LENGTH OF SPRING J ASSUMING THAT THE END HAS NOT REACHED THE FIRST CURB SLOPE
HJ<O OR HJ ≥ RW
T
TEST FOR LENGTH LIMITS
YJP=YP(I)+BMTX(2,3)*HJ
CALCULATE LATERAL POSITION OF END OF SPRING T
YJP< YC1P
T
TEST IS TRUE IF SPRING LENGTH AND POSITION COMPATIBLE, I.E. SPRING INTERSECTS THE GRO BEFORE FIRST CURB SLOPE
800
HJ = (ZP(1) + (YC1P YP(I)*TANPC1) / BMT X(2,3)*TANCP1-BMTX(3,3)
HJ<O OR HJ ≥ RW
T
TEST FOR LENGTH LIMITS
YJP=YP(I)+BMTX(2,3)*HJ
ZJP=ZP(I)+BMTX(3,3)*HJ
CALCULATE LATERAL POSITION AND ELEVATION END OF RADIAL SPRING J
PHGI(I) = 0.0
TYGP ≤ YC1P
T
YC1P < TYGP ≤ YC2P
T
PHGI(I) = PHIC1R
905
NCRBSL = 2
T
YC2P < TYGP ≤ YC3P
T
PHGI(I) = PHIC2R
915
NCRBSL = 3
T
YC3P < TYGP ≤ YC4P
T
PHGI(I) = PHIC3R
925
NCRBSL = 4
T
YC4P < TYGP ≤ YC5P
T
PHGI(I) = PHIC4R
935
NCRBSL = 5
T
YC5P < TYGP ≤ YC6P
T
PHGI(I) = PHIC5R
970
PHGI(I) = PHICLR
TCI=CAR(I)*CBYW(I)-CBR(I)*CAYW(I)
TAI=CBR(I)*CGYW(I)-CGR(I)*CBYW(I)
TBI=CGR(I)*CAYW(I)-CAR(I)*CGYW(I)
CPG(I)=COS(PHGI(I))
SPG(I)=SIN(PHGI(I))
CALCULATE DN1,DN2,DN3 PHGI(I),THGI(I) SPG(I),CPG(I) STG(I),CTG(I)
CALCULATE THE EQUIVALENT GROUND CONTACT POINT
CALCULATE XGPP(I),YGPP(I) ZGPP(I)
CALCULATE THE SLOPES OF THE EQUIVALENT GROUND PLANE
RETURN
END

12. SUBROUTINE CTQB

a. Purpose:

1. To calculate braking torques from hydraulic pressure, brake type and fade coefficient

b. Common Blocks Required:

INPT5, COMP5

c. Subroutines Required:

Function PARI

d. Arguments:

None

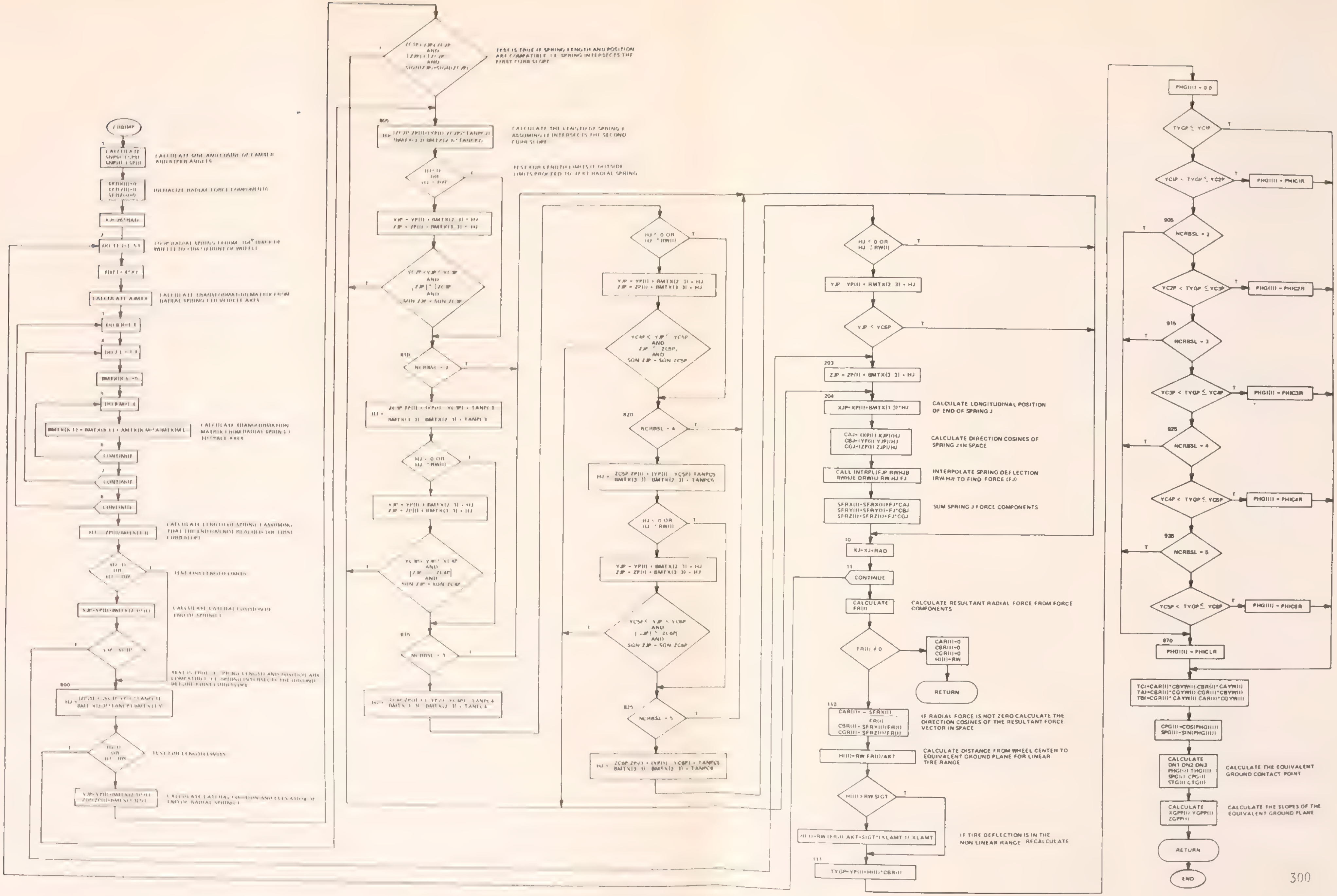
e. Common Variables Calculated:

NBTYP, PP, TQB

f. Size:

$52C)_{16} = 1324)_{10}$ bytes

g. Computational Procedure:



CALCULATE THE LENGTH OF SPRING J ASSUMING IT INTERSECTS THE SECOND CURB SLOPE
HJ < 0 OR HJ > RW(I)
YJP = YP(I) + BMTX(2 3) + HJ
YJP < YC6P
ZJP = ZP(I) + BMTX(3 3) + HJ
XJP=XP(I)+BMTX(1 3)*HJ
CALCULATE LONGITUDINAL POSITION OF END OF SPRING J
CAJ=(XP(I) XJP)/HJ
CBJ=(YP(I) YJP)/HJ
CGJ=(ZP(I) ZJP)/HJ
CALCULATE DIRECTION COSINES OF SPRING J IN SPACE
CALL INTRP(LFJP RWHJB RWHJE DRWHJ RW HJ FJ)
INTERPOLATE SPRING DEFLECTION (RW-HJ) TO FIND FORCE (FJ)
SFRX(I)=SFRX(I)+FJ*CAJ
SFRY(I)=SFRY(I)+FJ*CBJ
SFRZ(I)=SFRZ(I)+FJ*CGJ
SUM SPRING J FORCE COMPONENTS
XJ=XJ+RAD
CONTINUE
CALCULATE FR(I)
CALCULATE RESULTANT RADIAL FORCE FROM FORCE COMPONENTS
FR(I) ≠ 0
CAR(I)=0
CBR(I)=0
CGR(I)=0
H(I)=RW
RETURN
CAR(I)= - SFRX(I)/FR(I)
CBR(I)= SFRY(I)/FR(I)
CGR(I)= SFRZ(I)/FR(I)
IF RADIAL FORCE IS NOT ZERO CALCULATE THE DIRECTION COSINES OF THE RESULTANT FORCE VECTOR IN SPACE
H(I)=RW FR(I)/AKT
CALCULATE DISTANCE FROM WHEEL CENTER TO EQUIVALENT GROUND PLANE FOR LINEAR TIRE RANGE
H(I) > RW SIGT
IF TIRE DEFLECTION IS IN THE NON LINEAR RANGE RECALCULATE
TYGP=YP(I)+H(I)*CBR(I)
PHG(I) = 0.0
TYGP ≤ YC1P
YC1P < TYGP ≤ YC2P
PHG(I) = PHIC1R
NCRBSL = 2
YC2P < TYGP ≤ YC3P
PHG(I) = PHIC2R
NCRBSL = 3
YC3P < TYGP ≤ YC4P
PHG(I) = PHIC3R
NCRBSL = 4
YC4P < TYGP ≤ YC5P
PHG(I) = PHIC4R
NCRBSL = 5
YC5P < TYGP ≤ YC6P
PHG(I) = PHIC5R
PHG(I) = PHICLR
TCI=CAR(I)*CBYW(I) CBR(I)*CAYW(I)
TAI=CBR(I)*CGYW(I) CGR(I)*CBYW(I)
TBI=CGR(I)*CAYW(I) CAR(I)*CGYW(I)
CPG(I)=COS(PHG(I))
SPG(I)=SIN(PHG(I))
CALCULATE THE EQUIVALENT GROUND CONTACT POINT
CALCULATE THE SLOPES OF THE EQUIVALENT GROUND PLANE
RETURN
END

12. SUBROUTINE CTQB

a. Purpose:

1. To calculate braking torques from hydraulic pressure, brake type and fade coefficient

b. Common Blocks Required:

INPT5, COMP5

c. Subroutines Required:

Function PARI

d. Arguments:

None

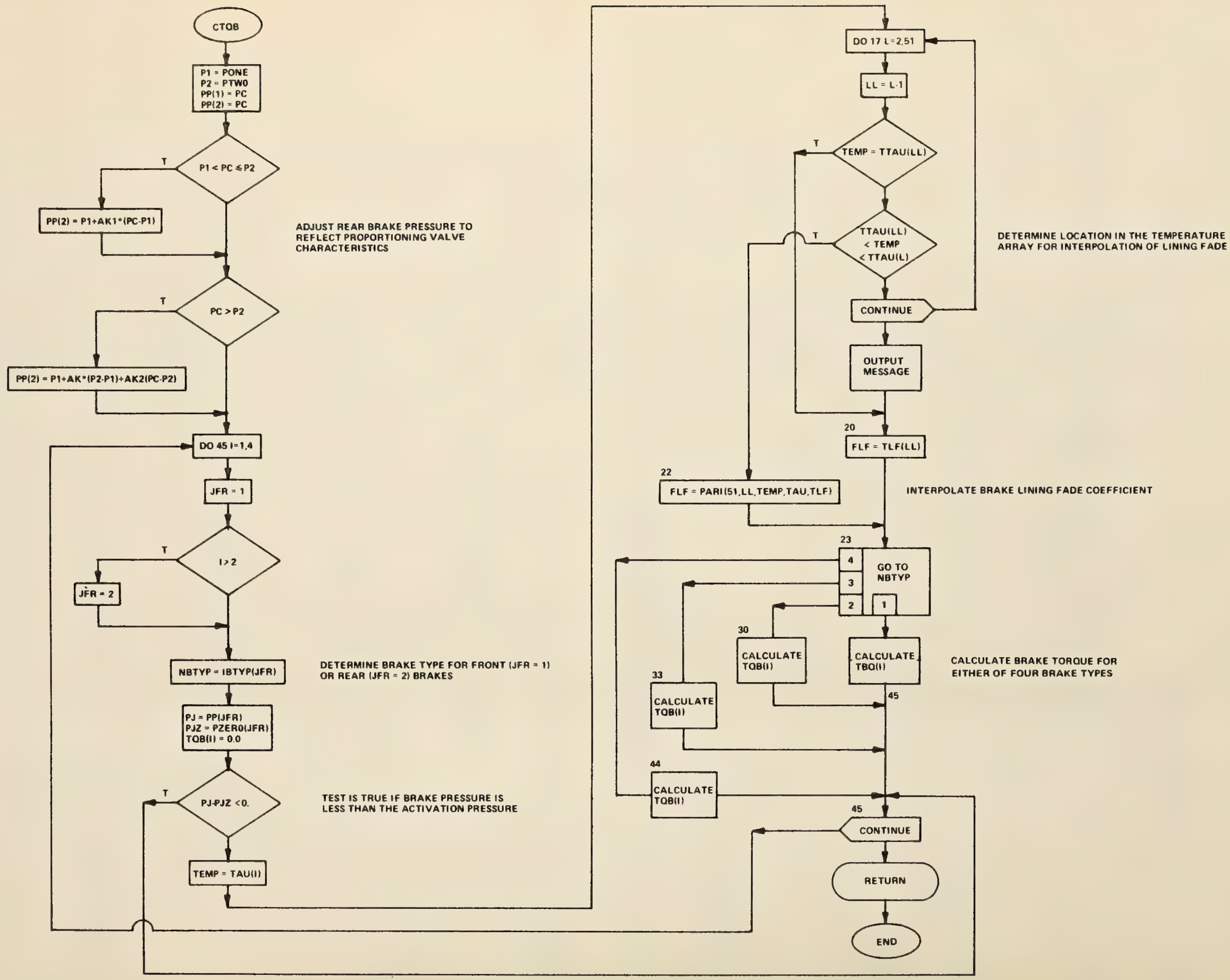
e. Common Variables Calculated:

NBTYP, PP, TQB

f. Size:

$52C)_{16} = 1324)_{10}$ bytes

g. Computational Procedure:


CTQB
P1 = PONE
P2 = PTWO
PP(1) = PC
PP(2) = PC
P1 < PC ≤ P2
T
PP(2) = P1+AK1*(PC-P1)
ADJUST REAR BRAKE PRESSURE TO REFLECT PROPORTIONING VALVE CHARACTERISTICS
PC > P2
T
PP(2) = P1+AK*(P2-P1)+AK2(PC-P2)
DO 45 I=1,4
JFR = 1
I > 2
T
JFR = 2
NBTYP = IBTYP(JFR)
DETERMINE BRAKE TYPE FOR FRONT (JFR = 1) OR REAR (JFR = 2) BRAKES
PJ = PP(JFR)
PJZ = PZERO(JFR)
TQB(I) = 0.0
PJ-PJZ <0.
T
TEST IS TRUE IF BRAKE PRESSURE IS LESS THAN THE ACTIVATION PRESSURE
TEMP = TAU(I)
DO 17 L=2,51
LL = L-1
TEMP = TTAU(LL)
T
TTAU(LL) < TEMP < TTAU(L)
T
DETERMINE LOCATION IN THE TEMPERATURE ARRAY FOR INTERPOLATION OF LINING FADE
CONTINUE
OUTPUT MESSAGE
20
FLF = TLF(LL)
22
FLF = PARI(51,LL,TEMP,TAU,TLF)
INTERPOLATE BRAKE LINING FADE COEFFICIENT
23
GO TO NBTYP
4
3
2
1
30
CALCULATE TQB(I)
CALCULATE TBQ(I)
CALCULATE BRAKE TORQUE FOR EITHER OF FOUR BRAKE TYPES
33
CALCULATE TQB(I)
45
44
CALCULATE TQB(I)
45
CONTINUE
RETURN
END

13. SUBROUTINE CTQD

a. Purpose:

1. To compute the driveline torque at the driving end of the vehicle from throttle setting, transmission ratio and engine speed

b. Common Blocks Required:

INTG, INTR, INPT4, INPT5, COMP5, DRIVTT, DRIVI, DRIVE

c. Subroutines Required:

Function PARI

d. Arguments:

None

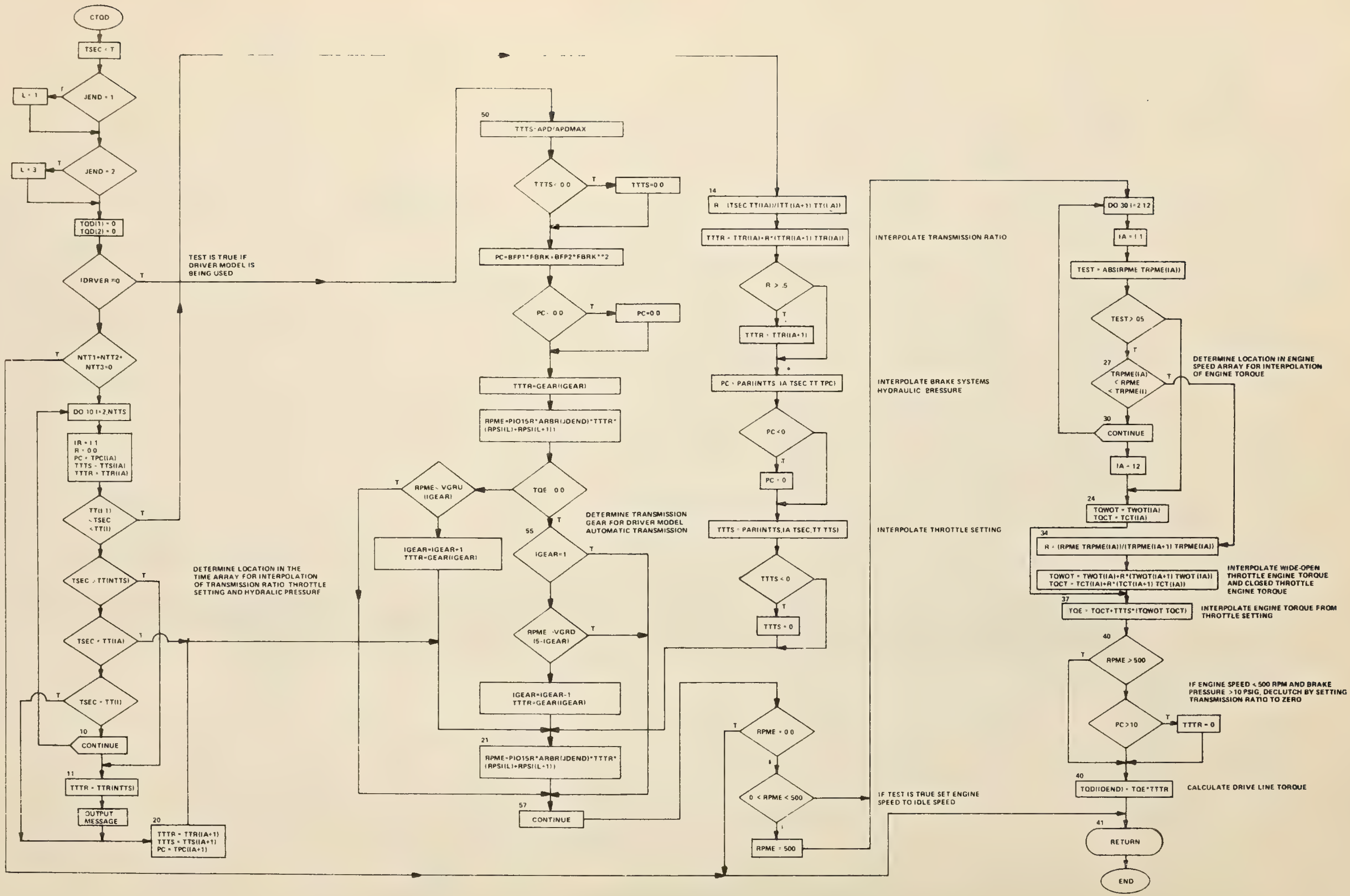
e. Common Variables Calculated:

PC, TQD, TQE, RPME, IGEAR

f. Size:

$6DE)_{16} = 1758)_{10}$ bytes

g. Computational Procedure:


CTOD
TSEC = T
JEND = 1
L = 1
JEND = 2
L = 3
TQD(1) = 0
TQD(2) = 0
IDRVER = 0
TEST IS TRUE IF DRIVER MODEL IS BEING USED
NTT1+NTT2+NTT3=0
DO 10 I=2,NTTS
IR = 1 1
R = 0 0
PC = TPC(IA)
TTTS = TTS(IA)
TTTR = TTR(IA)
TT(I 1) < TSEC < TT(I)
TSEC > TT(NTTS)
TSEC = TT(IA)
TSEC = TT(I)
10
CONTINUE
11
TTTR = TTR(NTTS)
OUTPUT MESSAGE
20
TTTR = TTR(IA+1)
TTTS = TTS(IA+1)
PC = TPC(IA+1)
DETERMINE LOCATION IN THE TIME ARRAY FOR INTERPOLATION OF TRANSMISSION RATIO THROTTLE SETTING AND HYDRALIC PRESSURF
50
TTTS=APD/APDMAX
TTTS< 0 0
TTTS=0 0
PC=BFP1*FBRK+BFP2*FBRK**2
PC< 0 0
PC=0 0
TTTR=GEAR(IGEAR)
RPME=PIO15R*ARBR(JDEND)*TTTR*(RPSI(L)+RPSI(L+1))
TQE 0 0
RPME< VGRU (IGEAR)
IGEAR=IGEAR+1
TTTR=GEAR(IGEAR)
DETERMINE TRANSMISSION GEAR FOR DRIVER MODEL AUTOMATIC TRANSMISSION
55
IGEAR=1
RPME VGRD (5-IGEAR)
IGEAR=IGEAR-1
TTTR=GEAR(IGEAR)
21
RPME=PIO15R*ARBR(JDEND)*TTTR*(RPSI(L)+RPSI(L+1))
57
CONTINUE
14
R (TSEC TT(IA))/(TT(IA+1) TT(IA))
TTTR = TTR(IA)+R*(TTR(IA+1) TTR(IA))
INTERPOLATE TRANSMISSION RATIO
R > .5
TTTR = TTR(IA+1)
PC = PAR(NTTS IA TSEC TT TPC)
INTERPOLATE BRAKE SYSTEMS HYDRAULIC PRESSURE
PC < 0
PC = 0
TTTS = PAR(NTTS,IA TSEC,TT TTS)
INTERPOLATE THROTTLE SETTING
TTTS < 0
TTTS = 0
RPME = 0 0
0 < RPME < 500
IF TEST IS TRUE SET ENGINE SPEED TO IDLE SPEED
RPME = 500
DO 30 I=2 12
IA = I 1
TEST = ABS(RPME TRPME(IA))
TEST > 05
27
TRPME(IA) < RPME < TRPME(I)
DETERMINE LOCATION IN ENGINE SPEED ARRAY FOR INTERPOLATION OF ENGINE TORQUE
30
CONTINUE
IA = 12
24
TQWOT = TWOT(IA)
TQCT = TCT(IA)
34
R = (RPME TRPME(IA))/(TRPME(IA+1) TRPME(IA))
TQWOT = TWOT(IA)+R*(TWOT(IA+1) TWOT (IA))
TQCT = TCT(IA)+R*(TCT(IA+1) TCT(IA))
INTERPOLATE WIDE-OPEN THROTTLE ENGINE TORQUE AND CLOSED THROTTLE ENGINE TORQUE
37
TQE = TQCT+TTTS*(TQWOT TQCT)
INTERPOLATE ENGINE TORQUE FROM THROTTLE SETTING
40
RPME > 500
IF ENGINE SPEED < 500 RPM AND BRAKE PRESSURE >10 PSIG, DECLUTCH BY SETTING TRANSMISSION RATIO TO ZERO
PC > 10
TTTR = 0
40
TQD(IDEND) = TQE*TTTR
CALCULATE DRIVE LINE TORQUE
41
RETURN
END

14. SUBROUTINE DATE

a. Purpose:

1. Return the calendar date in 8 byte form, e.g., 23MAR'68

b. Common Blocks Required:

None

c. Subroutines Required:

None

d. Arguments:

DADE - Array into which the date is loaded

e. Common Variables Calculated:

None

f. Size:

$D6)_{16} = 214)_{10}$ bytes

g. Procedure:

This subroutine is written in IBM S/360 Assembler Language

15. SUBROUTINE DAUX

a. Purpose:

1. Evaluate the derivatives of the dependent variables for subsequent integration in PINT1

b. Common Blocks Required:

INPT, INPT1, INTG, DIMV, COMP, COMPN, ADTNL, COMP4, INPT4, INTR, INSUS, SUSCMP

c. Subroutines Required:

VPOS, VGORNT, MATRIX, SIMSOL, CTQB, SUSFRC, CTQD, TMCNST, TIRFR, UMOMNT, MTRXIR, MTRXSF

d. Arguments:

None

e. Common Variables Calculated:

DP, DQ, DR, DU, DV, DW, DXCP, DYCP, DZCP, GAM2, GAM3, GAM4, GAM5, GAM6, GAM7, GAM8, GAM9, XIXP, XIYP, XIZP, DDEL1, DDEL2, DDEL3, DDEL4, DPHIF, DPHIR, T1PSI, T2PSI, XIXZP, XIYZP, DDEL1D, DDEL2D, DDEL3D, DDEL4D, DDPSFI, DPHIFD, DPHIRD, DPHITP, DPSIFI, DPSITP, DTHTTP

f. Size:

$B52)_{16} = 2898)_{10}$ bytes

g. Computational Procedure:

1. Test for abnormal program stop (ISTOP≠0) and return if indicated.
2. Calculate time dependent variables by calling subroutine TMCNST.
3. Calculate time dependent inertial terms: XIXP, XIYP, XIZP, XIXZP, XIYZP, GAM2, GAM3, GAM4, GAM5, GAM6, GAM7, GAM8, GAM9. Note that these variables differ with the suspension option in effect, thus branching to the appropriate set of calculation occurs based on ISUS.
4. Call subroutines VPOS and VGORNT to determine the position and orientation of the vehicle.
5. Calculate suspension displacements and velocities depending on suspension option.
6. Call subroutines SUSFRC to calculate suspension forces, and UMOMNT to calculate moments acting on the sprung mass and solid axles (if being used).
7. Depending on the suspension option in effect, call either subroutine MATRIX, MTRXIR or MTRXSF to evaluate the inertial matrix and forcing function stored in the array DMATX.

8. Call subroutine SIMSOL to solve the 10x10 set of simultaneous equations of motion for the 10 derivatives of the dependent variables.
9. Set the solution vector from SIMSOL, DMATX(I,11), to the appropriate variable names and set the remaining 10 derivatives depending on suspension option.
10. Compute the derivatives of the steering degree-of-freedom if in effect as indicated by either INDCRB<0 or IHIT=1 and INDCRB>0.

16. SUBROUTINE DAUXR(NTRA)

a. Purpose:

1. Calculate tire side and circumferential forces
2. Calculate time derivatives of wheel spin velocities

b. Common Blocks Required:

DIMV, COMPN, INPT4, COMP4, INPT5, COMP5, TIRIN, INTR

c. Subroutines Required:

INTPR, ADJTQB

d. Arguments:

NTRA = 1 for initialization of wheel spin derivatives
2 for integration of wheel spin derivatives

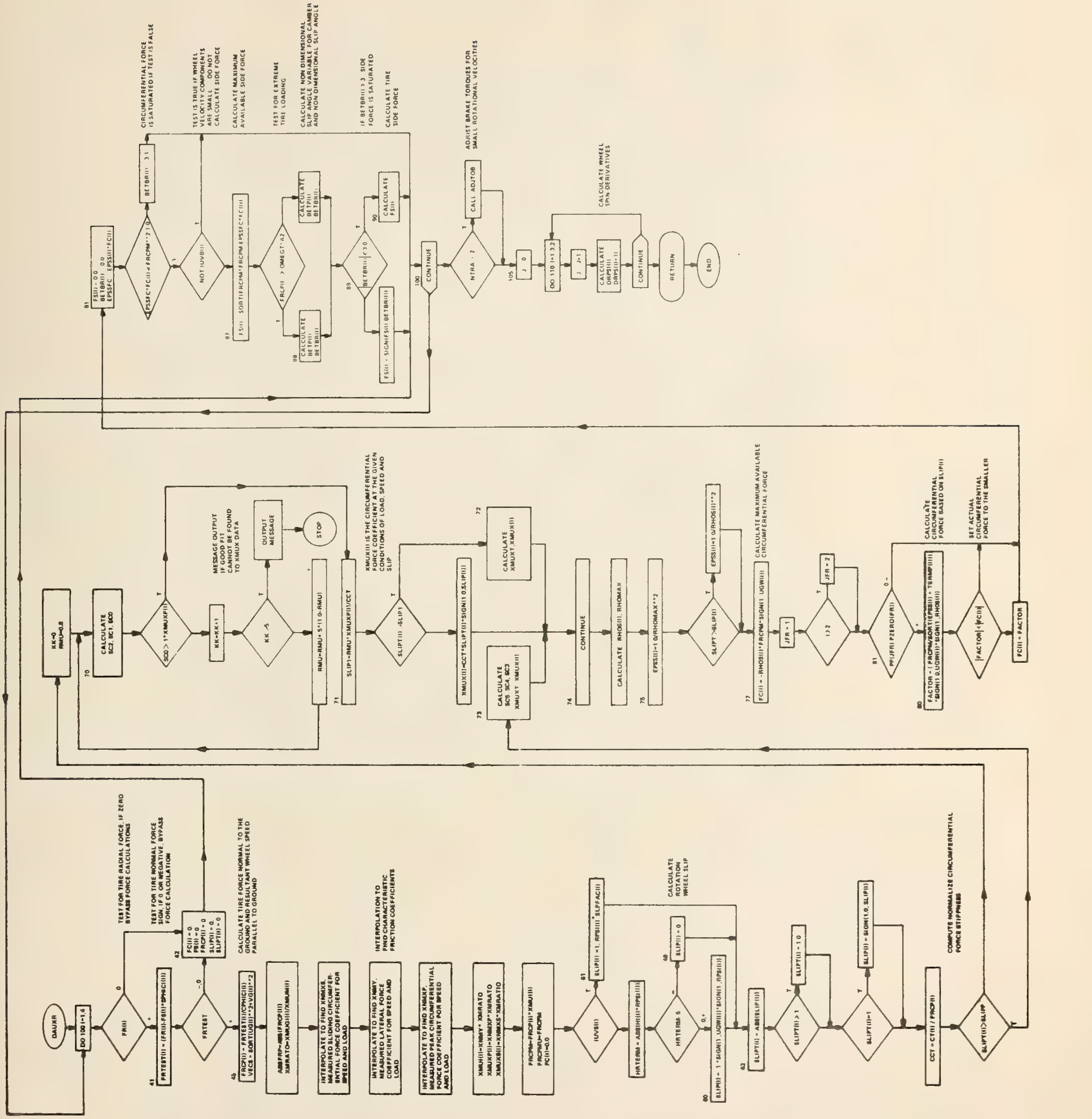
e. Common Variables Calculated:

FC, FS, RRM, UGW, BETP, EPSS, FRCP, RHOS, SLIP, VECS, BETBR, DRPSI, SLIPP, SLIPT, XMUXP, XMUXS, EPSSFC, FRCPMU, FRTEST, HRTERM, NXFRCP, NXUGMU, RHOMAX, SLIPMT, XMUMAT, XMXPMT, XMXSMT, XXFRCP, XXUGMU

f. Size:

$BBA)_{16} = 3002)_{10}$ bytes

g. Computational Procedure:


DAUXR
DO 100 I=1,4
FR(I)
TEST FOR TIRE RADIAL FORCE, IF ZERO BYPASS FORCE CALCULATIONS
FRTEST(I) = (FR(I)-FS(I)*SPHIC(I))
TEST FOR TIRE NORMAL FORCE SIGN, IF 0 OR NEGATIVE, BYPASS FORCE CALCULATION
FRTEST
FC(I) = 0
FS(I) = 0
FRCP(I) = 0
SLIP(I) = 0
SLIPT(I) = 0
FRCP(I) = FRTEST(I)/CPHIC(I)
VECS = SQRT(UG(I)**2+VG(I)**2)
CALCULATE TIRE FORCE NORMAL TO THE GROUND AND RESULTANT WHEEL SPEED PARALLEL TO GROUND
ABSFRP=ABS(FRCP(I))
XMRATO=XMUG(I)/XMUM(I)
INTERPOLATE TO FIND XNMXS, MEASURED SLIDING CIRCUMFERENTIAL FORCE COEFFICIENT FOR SPEED AND LOAD
INTERPOLATE TO FIND XNMY, MEASURED LATERAL FORCE COEFFICIENT FOR SPEED AND LOAD
INTERPOLATION TO FIND CHARACTERISTIC FRICTION COEFFICIENTS
INTERPOLATE TO FIND XNMXP, MEASURED PEAK CIRCUMFERENTIAL FORCE COEFFICIENT FOR SPEED AND LOAD
XMUH(I)=XNMY*XMRATO
XMUXP(I)=XNMXP*XMRATO
XMUXS(I)=XNMXS*XMRATIO
FRCPM=FRCP(I)*XMU(I)
FRCPMU=FRCPM
FC(I)=0.0
IUVS(I)
SLIP(I) =1, RPS(I) SLPFAC(I)
HRTERM = ABS(H(I)*RPS(I))
HRTERM .5
SLIP(I) = 0
CALCULATE ROTATION WHEEL SLIP
SLIP(I) = 1*SIGN(1.,UGW(I))*SIGN(1.,RPS(I))
SLIPT(I) = ABS(SLIP(I))
SLIPT(I) > 1
SLIPT(I) = 1.0
SLIPT(I)=1
SLIP(I) = SIGN(1.0, SLIP(I))
CCT = CT(I) / FRCP(I)
COMPUTE NORMALIZE CIRCUMFERENTIAL FORCE STIFFNESS
SLIPT(I)>SLIPP
KK=0
RMU=0.8
CALCULATE SC2, SC1, SC0
SC0 > 1*XMUXP(I)
KK=KK+1
MESSAGE OUTPUT IF GOOD FIT CANNOT BE FOUND TO XMUX DATA
KK .5
OUTPUT MESSAGE
STOP
RMU=RMU+.5*(1.0-RMU)
SLIP1=RMU*XMUXP(I)/CCT
XMUX(I) IS THE CIRCUMFERENTIAL FORCE COEFFICIENT AT THE GIVEN CONDITIONS OF LOAD, SPEED AND SLIP
SLIPT(I) .SLIP1
XMUX(I)=CCT*SLIPT(I)*SIGN(1.0,SLIP(I))
CALCULATE SC6, SC4, SC3 XMUXT, XMUX(I)
CALCULATE XMUXT, XMUX(I)
CONTINUE
CALCULATE RHOS(I), RHOMAX
EPSS(I)=1.0/RHOMAX**2
SLIPT >SLIP(I)
EPSS(I)=1.0/RHOS(I)**2
FC(I) = -RHOS(I)*FRCPM*SIGN(1.,UGW(I))
CALCULATE MAXIMUM AVAILABLE CIRCUMFERENTIAL FORCE
JFR = 1
I>2
JFR = 2
PP(JFR) PZERO(FR(I))
FACTOR = (FRCPM/SQRT(EPSS(I) + TERMP(I)))
*SIGN(1.0,UGW(I))*SIGN(1.,RHOS(I))
CALCULATE CIRCUMFERENTIAL FORCE BASED ON SLIP(I)
|FACTOR| < |FC(I)|
SET ACTUAL CIRCUMFERENTIAL FORCE TO THE SMALLER
FC(I) = FACTOR
FS(I) = 0.0
BETBR(I) 0.0
EPSSFC EPSS(I)*FC(I)
EPSSFC*FC(I) < FRCPM**2 1.0
BETBR(I) 3.1
CIRCUMFERENTIAL FORCE IS SATURATED IF TEST IS FALSE
NOT IUVB(I)
TEST IS TRUE IF WHEEL VELOCITY COMPONENTS ARE SMALL DO NOT CALCULATE SIDE FORCE
FS(I) SQRT(FRCPM*FRCPM-EPSSFC*FC(I))
CALCULATE MAXIMUM AVAILABLE SIDE FORCE
FRCP(I) > OMEGT*A2
TEST FOR EXTREME TIRE LOADING
CALCULATE BETP(I) BETBR(I)
CALCULATE NON DIMENSIONAL SLIP ANGLE VARIABLE FOR CAMBER AND NON DIMENSIONAL SLIP ANGLE
BETBR(I) < 3.0
IF BETBR(I) > 3 SIDE FORCE IS SATURATED
FS(I) SIGN(FS(I) BETBR(I))
CALCULATE FS(I)
CALCULATE TIRE SIDE FORCE
CONTINUE
NTRA 2
CALL ADJTOB
ADJUST BRAKE TORQUES FOR SMALL ROTATIONAL VELOCITIES
J 0
DO 110 I=1,3,2
J J+1
CALCULATE DRPS(I) DRPS(I+1)
CALCULATE WHEEL SPIN DERIVATIVES
CONTINUE
RETURN
END

17. SUBROUTINE DRIVER

a. Purpose:

1. Compute the front wheel steer angle and angular velocity based on either the path following or skid control modes of driver operation
2. Obtain accelerator pedal deflection or brake pedal force for speed control mode of operation

b. Common Blocks Required:

INPT1, INTG, DIMV, COMP, EINDEX, DRIVTT, DRIVI, DRIVE

c. Subroutines Required:

DRIVP

d. Arguments:

PHIFF - computed front wheel steer angle
PSIFFD - computed front wheel steer angular velocity
JJ - indicator, set≠0 when subroutine DRIVER has calculated PSIFF and PSIFFD

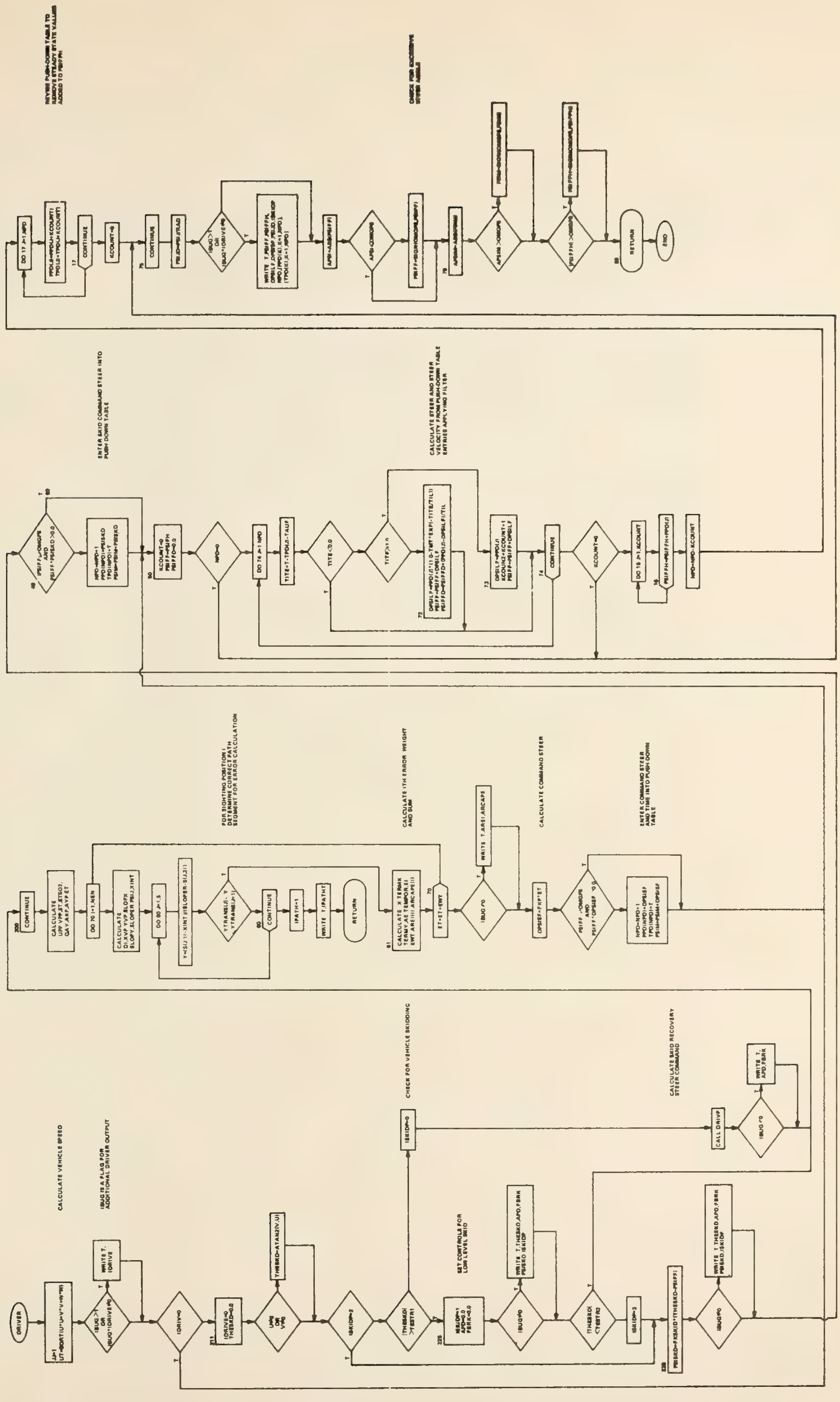
e. Common Variables Calculated:

X, Y, AE, DI, EI, ET, ST, UT, APD, AXP, AYP, EWT, NPD, PPD, QAY, TPD, XVP, YVP, APSI, AREI, FBRK, PSIM, TITE, XINT, APSIM, PSIJD, STS02, TERMX, TERMY, ARCAPE, DPSILF, DPSISF, IDRIVE, IPATHT, ISKIDP, KCOUNT, PHIFFD, PSIFFH, PSISKD, SLOPER, TEMPOR, THESKD

f. Size:

$C06)_{16} = 3078)_{10}$ bytes

g. Computational Procedure:



18. SUBROUTINE DRIVID

a. Purpose:

1. Printout driver control inputs

b. Common Blocks Required:

INPT, HEAD, DRIVI, DRIVE, DRIVTT

c. Subroutines Required:

None

d. Arguments:

None

e. Common Variables Calculated:

None

f. Size:

$BB0)_{16} = 2992)_{10}$ bytes

19. SUBROUTINE DRIVP

a. Purpose:

1. Compute accelerator pedal deflection or brake pedal force for driver speed control

b. Common Blocks Required:

DRIVTT, DRIVI, DRIVE

c. Subroutines Required:

None

d. Arguments:

None

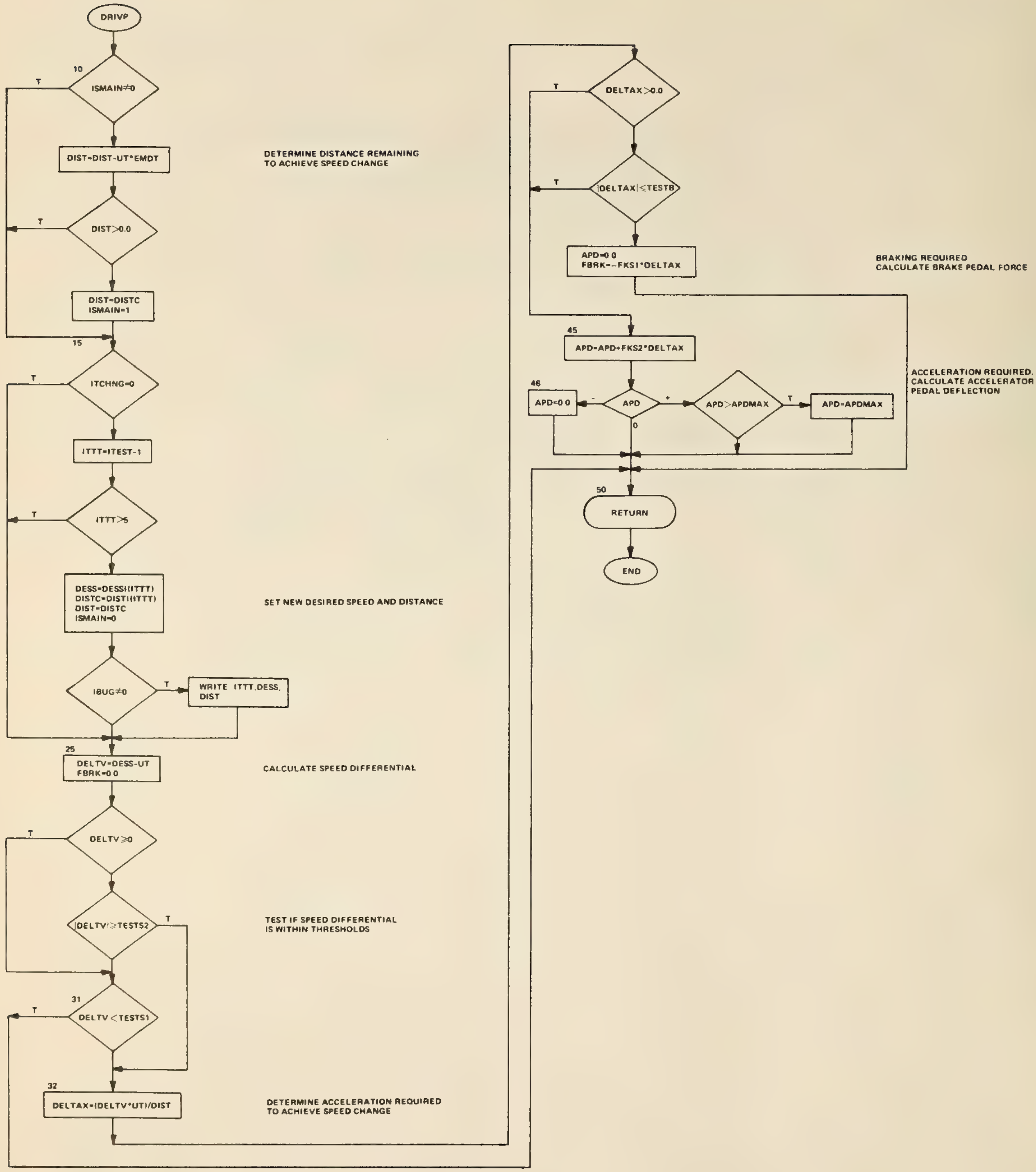
e. Common Variables Calculated:

APD, DESS, DIST, FBRK, DELTV, DISTC, DELTAX, ISMAIN

f. Size:

$24E)_{16} = 590)_{10}$ bytes

g. Computational Procedure:


DRIVP
10
ISMAIN≠0
T
DIST=DIST-UT*EMDT
DETERMINE DISTANCE REMAINING TO ACHIEVE SPEED CHANGE
DIST>0.0
DIST=DISTC
ISMAIN=1
15
ITCHNG=0
ITTT=ITEST-1
ITTT>5
DESS=DESS(ITTT)
DISTC=DIST(ITTT)
DIST=DISTC
ISMAIN=0
SET NEW DESIRED SPEED AND DISTANCE
IBUG≠0
WRITE ITTT,DESS, DIST
25
DELTV=DESS-UT
FBRK=0.0
CALCULATE SPEED DIFFERENTIAL
DELTV≥0
\|DELTV\|≥TESTS2
TEST IF SPEED DIFFERENTIAL IS WITHIN THRESHOLDS
31
DELTV<TESTS1
32
DELTAX=(DELTV*UT)/DIST
DETERMINE ACCELERATION REQUIRED TO ACHIEVE SPEED CHANGE
DELTAX>0.0
\|DELTAX\|≤TESTB
APD=0.0
FBRK=-FKS1*DELTAX
BRAKING REQUIRED
CALCULATE BRAKE PEDAL FORCE
45
APD=APD+FKS2*DELTAX
ACCELERATION REQUIRED.
CALCULATE ACCELERATOR PEDAL DEFLECTION
46
APD=0.0
APD
APD>APDMAX
APD=APDMAX
50
RETURN
END

20. SUBROUTINE DRVCNS

a. Purpose:

1. Calculate variables used in subroutine DRIVER
2. Initialize accelerator pedal deflection for constant speed

b. Common Blocks Required:

INPT, INPT1, COMP, COMPN, DIMV, INPT4, INPT5, COMP5, INTR, DRIVTT, DRIVI, DRIVE

c. Subroutines Required:

None

d. Arguments:

None

e. Common Variables Calculated:

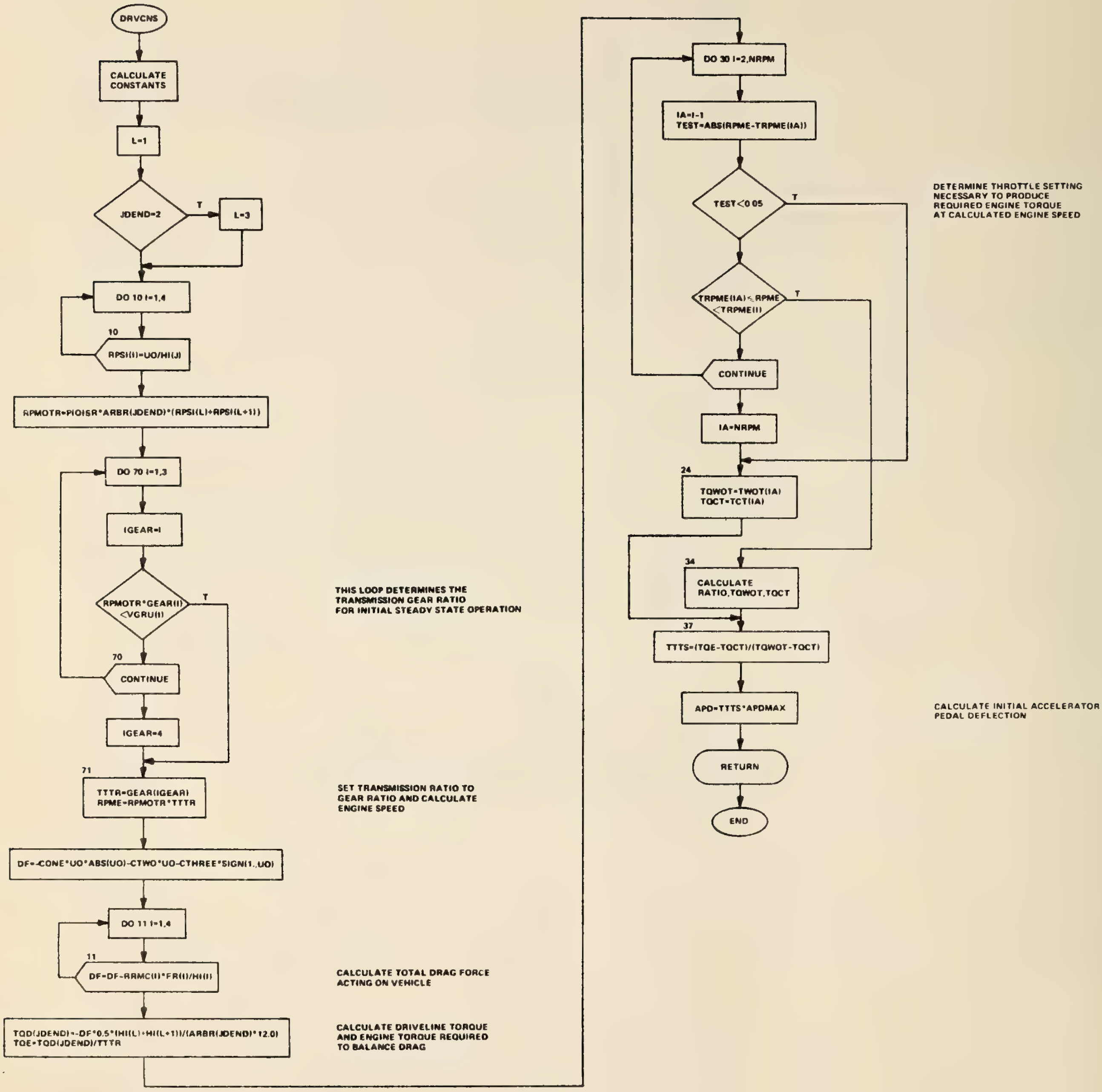
DI, APB, APD, FKD, FKP, TMT, TQD, TQE, DESS, DIST, FBRK, FKS1, FKS2, RPME, RPSI, DISTC, IGEAR, OMGPS, TESTB, TPATH, TRKIN, CONMPH, DELPTH, FKSKID, IDRIVE, ISMAIN, ITCHNG, ITESTT, TCTEST, TESTR1, TESTR2, TESTS1, TESTS2, THESKD, TTPSIT, WEIGHT

f. Size:

$642)_{16} = 1602)_{10}$ bytes

g. Computational Procedure:

1. Compute constants required by DRIVER.
2. Initialize accelerator pedal deflection as shown:



DRVCNS
CALCULATE CONSTANTS
L=1
JDEND=2
T
L=3
DO 10 I=1,4
10
RPSI(I)=UO/HI(J)
RPMOTR=PIOISR*ARBR(JDEND)*(RPSI(L)+RPSI(L+1))
DO 70 I=1,3
IGEAR=I
RPMOTR*GEAR(I) <VGRU(I)
T
THIS LOOP DETERMINES THE TRANSMISSION GEAR RATIO FOR INITIAL STEADY STATE OPERATION
70
CONTINUE
IGEAR=4
71
TTTR=GEAR(IGEAR)
RPME=RPMOTR*TTTR
SET TRANSMISSION RATIO TO GEAR RATIO AND CALCULATE ENGINE SPEED
DF=-CONE*UO*ABS(UO)-CTWO*UO-CTHREE*SIGN(1.,UO)
DO 11 I=1,4
11
DF=DF-RRMC(I)*FR(I)/HI(I)
CALCULATE TOTAL DRAG FORCE ACTING ON VEHICLE
TQD(JDEND)=-DF*0.5*(HI(L)+HI(L+1))/(ARBR(JDEND)*12.0)
TQE=TQD(JDEND)/TTTR
CALCULATE DRIVELINE TORQUE AND ENGINE TORQUE REQUIRED TO BALANCE DRAG
DO 30 I=2,NRPM
IA=I-1
TEST=ABS(RPME-TRPME(IA))
TEST<0.05
T
DETERMINE THROTTLE SETTING NECESSARY TO PRODUCE REQUIRED ENGINE TORQUE AT CALCULATED ENGINE SPEED
TRPME(IA)≤RPME <TRPME(I)
T
CONTINUE
IA=NRPM
24
TQWOT=TWOT(IA)
TQCT=TCT(IA)
34
CALCULATE RATIO,TQWOT,TQCT
37
TTTS=(TQE-TQCT)/(TQWOT-TQCT)
APD=TTTS*APDMAX
CALCULATE INITIAL ACCELERATOR PEDAL DEFLECTION
RETURN
END

21. SUBROUTINE DVDCHK

a. Purpose:

1. This subroutine processes interuptions caused by arithmetic instructions

b. Common Blocks Required:

None

c. Subroutines Required:

None

d. Arguments:

None

e. Common Variables Calculated:

None

f. Size:

$452)_{16} = 1108)_{10}$ bytes

g. Procedure:

A call to DVDCHK processes the following interruptions:

1. fixed point divide exception
2. exponent overflow exception
3. exponent underflow exception
4. floating point divide exception

This subroutine is written in IBM Assembler Language. The services provided are also given by extended FORTRAN error handling.

22. SUBROUTINE GCP(I)

a. Purpose:

1. Compute the coordinates of the tire ground contact point in space
2. Compute the rolling radius of the tire
3. Compute the direction and magnitude of the tire radial force

b. Common Blocks Required:

DIMV, COMP, TIRIN

c. Subroutines Required:

SIMSOL

d. Arguments:

The argument I indicates the wheel number for which calculations are made

e. Common Variables Calculated:

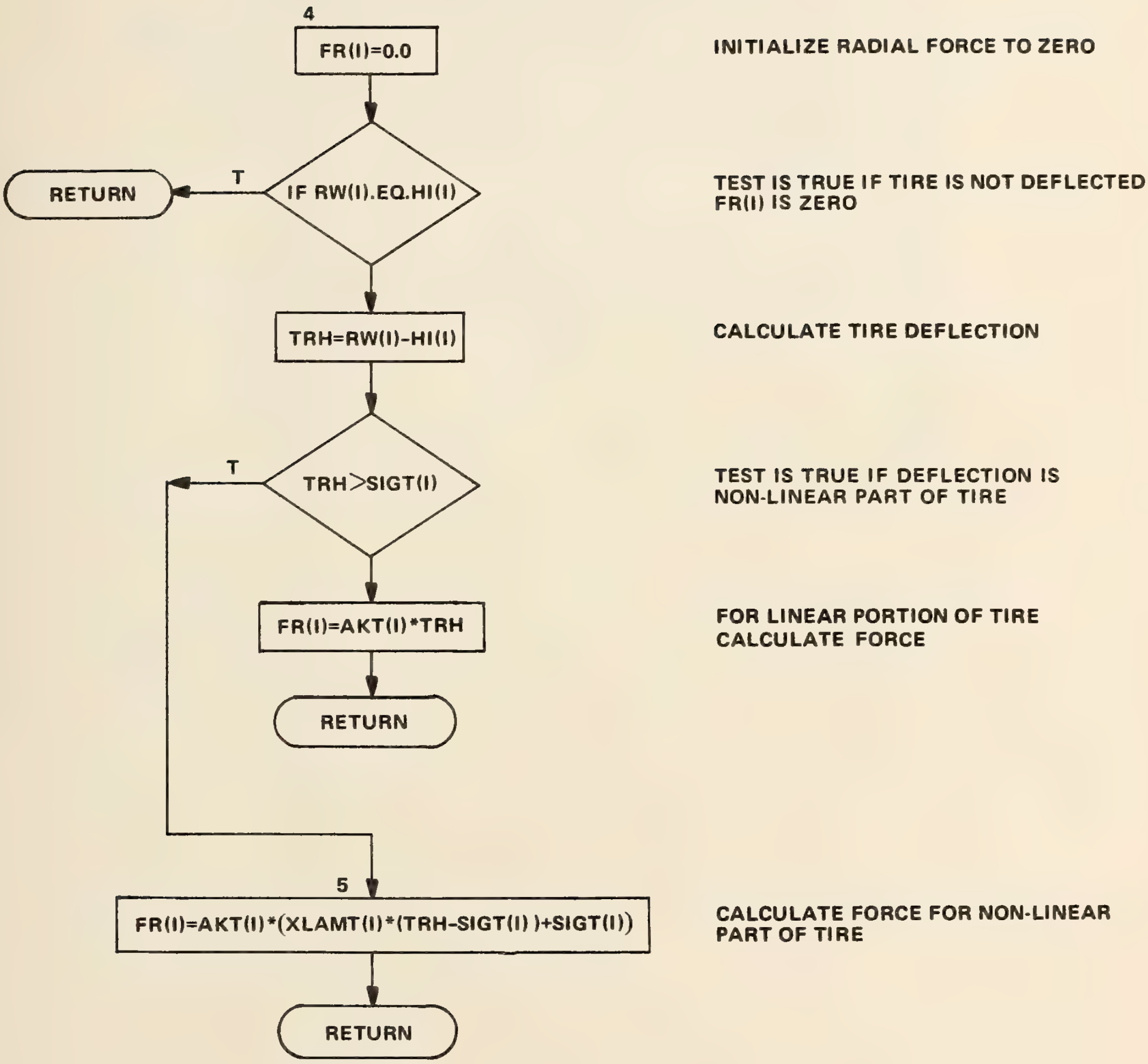
CAR, CBR, CGR, CMTX, DELTA, FR, HI, TRH, TX, TY, TZ, XGPP, XLM1, XLM2, XLM3, YGPP, ZGPP

f. Size:

$36C)_{16} = 876)_{10}$ bytes

g. Computational Procedure:

1. Calculate the coordinates of the ground contact point by simultaneous solution of the intersection of three planes: the wheel plane (normal direction CAYW(I), CBYW(I), CGYW(I)); the ground plane (normal direction CAGZ(I), CBGZ(I), CGGZ(I)); and a plane perpendicular to both passing through the wheel center (normal direction D1(I), D2(I), D3(I)). The simultaneous solution is performed by SIMSOL with the CMTX array containing the above direction cosines and the target array (XLM1(I), XLM2(I), XLM3(I)) contained in the fourth column of CMTX. The solution is returned in the fourth column of CMTX and set to the coordinates of the ground contact point (XGPP(I), YGPP(I), ZGPP(I)).
2. Calculate the distance between the wheel center and ground contact point, DELTA(I).
3. Calculate the direction cosines of the line of action of the tire radial force with respect to the space axes (CAR(I), CBR(I), CGR(I)).
4. Determine the rolling radius, HI(I).
5. Calculate the radial tire force, FR(I), as shown:


4
FR(I)=0.0
INITIALIZE RADIAL FORCE TO ZERO
RETURN
T
IF RW(I).EQ.HI(I)
TEST IS TRUE IF TIRE IS NOT DEFLECTED
FR(I) IS ZERO
TRH=RW(I)-HI(I)
CALCULATE TIRE DEFLECTION
T
TRH>SIGT(I)
TEST IS TRUE IF DEFLECTION IS
NON-LINEAR PART OF TIRE
FR(I)=AKT(I)*TRH
FOR LINEAR PORTION OF TIRE
CALCULATE FORCE
RETURN
5
FR(I)=AKT(I)*(XLAMT(I)*(TRH-SIGT(I))+SIGT(I))
CALCULATE FORCE FOR NON-LINEAR
PART OF TIRE
RETURN

23. SUBROUTINE IDOUT

a. Purpose:

1. Print input values with units and headings

b. Common Blocks Required:

HEAD, INPT, INPT1, COMP, APTABL, INPT3, INPT4, TIRIN, DRIVTT, NEWCRB

c. Subroutines Required:

DRIVID, IDOUTA

d. Arguments:

None

e. Common Variables Calculated:

None

f. Size:

$4548)_{16} = 17736)_{10}$ bytes

24. SUBROUTINE IDOUTA

a. Purpose:

1. Print input table values

b. Common Blocks Required:

HEAD, INPT4, INPT5

c. Subroutines Required:

None

d. Arguments:

HDD - array containing run title
DATE - array containing current date

e. Variables Calculated:

None

f. Size:

$1176)_{16} = 4470)_{10}$ bytes

25. SUBROUTINE INITEQ

a. Purpose:

1. To perform calculations to situate the vehicle in initial vertical equilibrium on flat, level terrain

b. Common Blocks Required:

INPT, COMP, DIMV, COMPN, INSUS, TIRIN

c. Subroutines Required:

None

d. Arguments:

None

e. Common Variables Calculated:

FR, HI, ZF, ZR

f. Size:

$324)_{16} = 804)_{10}$ bytes

g. Computational Procedure:

If ZF and ZR are input as zero, this subroutine calculates these variables based on the requirement for initial vertical equilibrium of the vehicle. Also calculated are tire radial forces and rolling radii.

26. SUBROUTINE INPUT

a. Purpose:

1. Obtain card input
2. Print card images

b. Common Blocks Required:

None

c. Subroutines Required:

BLK01, BLK02, BLK03, BLK04, BLK05, BLK06

d. Arguments:

None

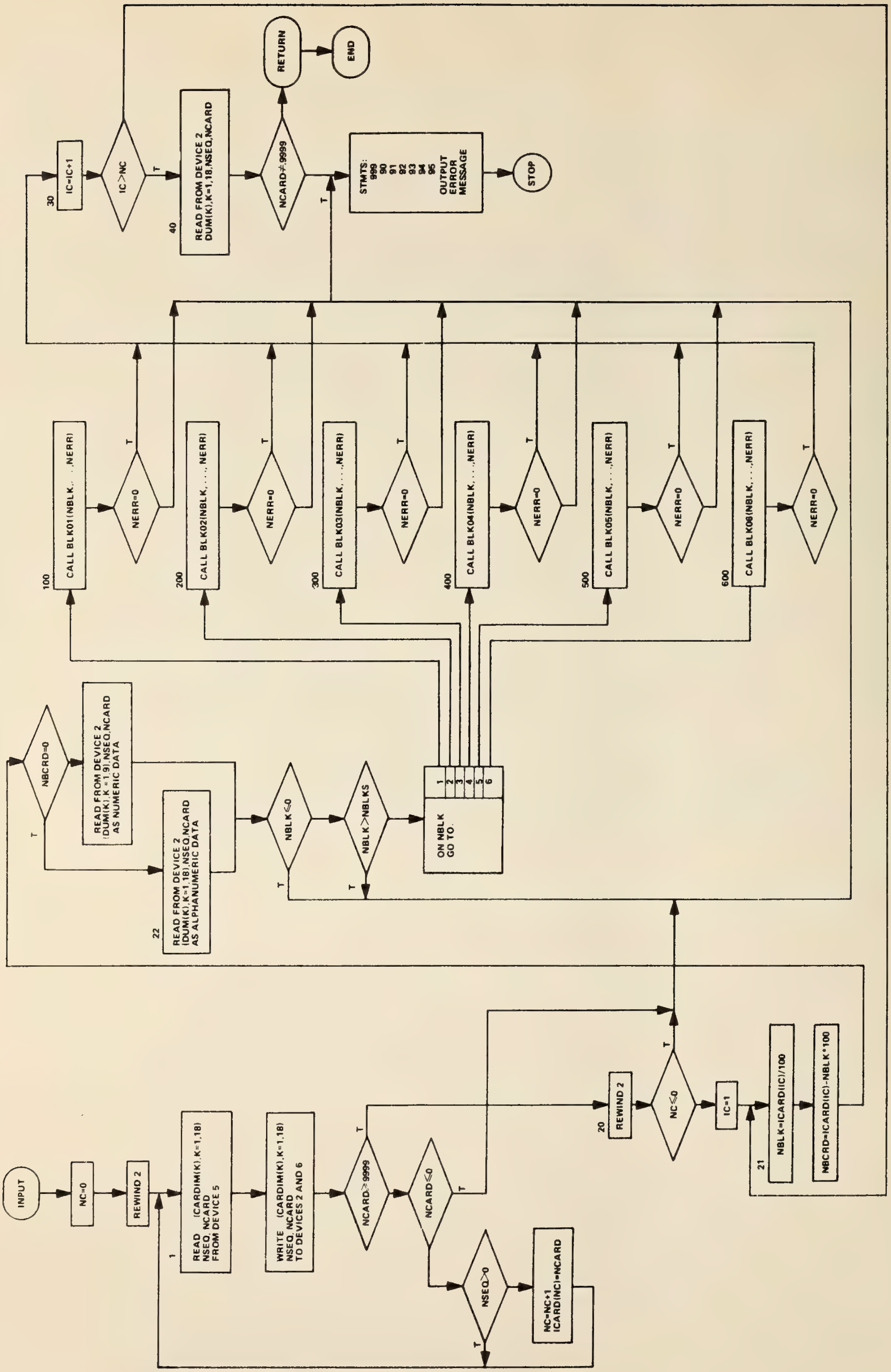
e. Common Variables Calculated:

None

f. Size:

$D5E)_{16} = 3422)_{10}$ bytes

g. Computational Procedure:


INPUT
NC=0
REWIND 2
1
READ (CARDIM(K),K=1,18) NSEQ, NCARD FROM DEVICE 5
WRITE (CARDIM(K),K=1,18) NSEQ, NCARD TO DEVICES 2 AND 6
NCARD≥9999
NCARD≤0
NSEQ>0
NC=NC+1 ICARD(NC)=NCARD
T
20
REWIND 2
NC≤0
IC=1
21
NBLK=ICARD(IC)/100
NBCRD=ICARD(IC)-NBLK*100
NBCRD=0
22
READ FROM DEVICE 2 (DUM(K),K=1,18),NSEQ,NCARD AS ALPHANUMERIC DATA
READ FROM DEVICE 2 (DUM(K),K=1,9),NSEQ,NCARD AS NUMERIC DATA
NBLK≤0
NBLK>NBLKS
ON NBLK GO TO
1 2 3 4 5 6
100
CALL BLK01(NBLK,...,NERR)
200
CALL BLK02(NBLK,...,NERR)
300
CALL BLK03(NBLK,...,NERR)
400
CALL BLK04(NBLK,...,NERR)
500
CALL BLK05(NBLK,...,NERR)
600
CALL BLK06(NBLK,...,NERR)
NERR=0
30
IC=IC+1
IC>NC
40
READ FROM DEVICE 2 DUM(K),K=1,18,NSEQ,NCARD
NCARD≠9999
RETURN
END
STMTS: 999 90 91 92 93 94 95 OUTPUT ERROR MESSAGE
STOP

27. SUBROUTINE INTPR(F,XMA, ALP, NM, NA, XM, AX, ANS, ERR, ND1)

a. Purpose:

1. Interpolate a two dimensional table

b. Common Blocks Required:

None

c. Subroutines Required:

None

d. Arguments:

F - two dimensional array containing values to be interpolated
XMA - one dimensional array containing values corresponding to the first dimension of F
ALP - one dimensional array containing values corresponding to the second dimension of F
NM - size of the XMA array
NA - size of the ALP array
XM - target value along the XMA dimension
AX - target value along the ALP dimension
ANS - interpolated value of the F array at (XM,AX)
ERR - error flag
ND1 - size of the first dimension of the F array

e. Common Variables Calculated:

None

f. Size:

$428)_{16} = 1064)_{10}$ bytes

g. Computational Procedure:

The answer is obtained by linear interpolation first along the XMA dimension, then along the ALP dimension.

28. SUBROUTINE INTRPL

a. Purpose:

1. To obtain a quadratic interpolation of a one-dimensional table

b. Common Blocks Required:

None

c. Subroutines Required:

None

d. Arguments:

TABLE - one-dimensional array of data
XMIN - minimum abscissa value
XMAX - maximum abscissa value
DX - abscissa increment
X - abscissa value at which ordinate is desired
Y - ordinate at X

e. Common Variables Calculated:

None

f. Size:

$3C2)_{16} = 962)_{10}$ bytes

g. Procedure:

1. Quadratic interpolation of the values of TABLE at X
2. ENTRY INTRPC also includes the additional argument SLOPE which is calculated as $\frac{d(TABLE)}{dx}$ at X

29. SUBROUTINE INTRP5(INDX)

a. Purpose:

1. Calculate the elevation and slopes under the wheel indicated by the argument INDX
2. Set the nominal friction coefficients according to the table for the wheel location

b. Common Blocks Required:

INPT, INPT1, INTG, DIMV, COMP, COMPN, ADTNL

c. Subroutines Required:

None

d. Arguments:

INDX - wheel number for which calculations are to be made

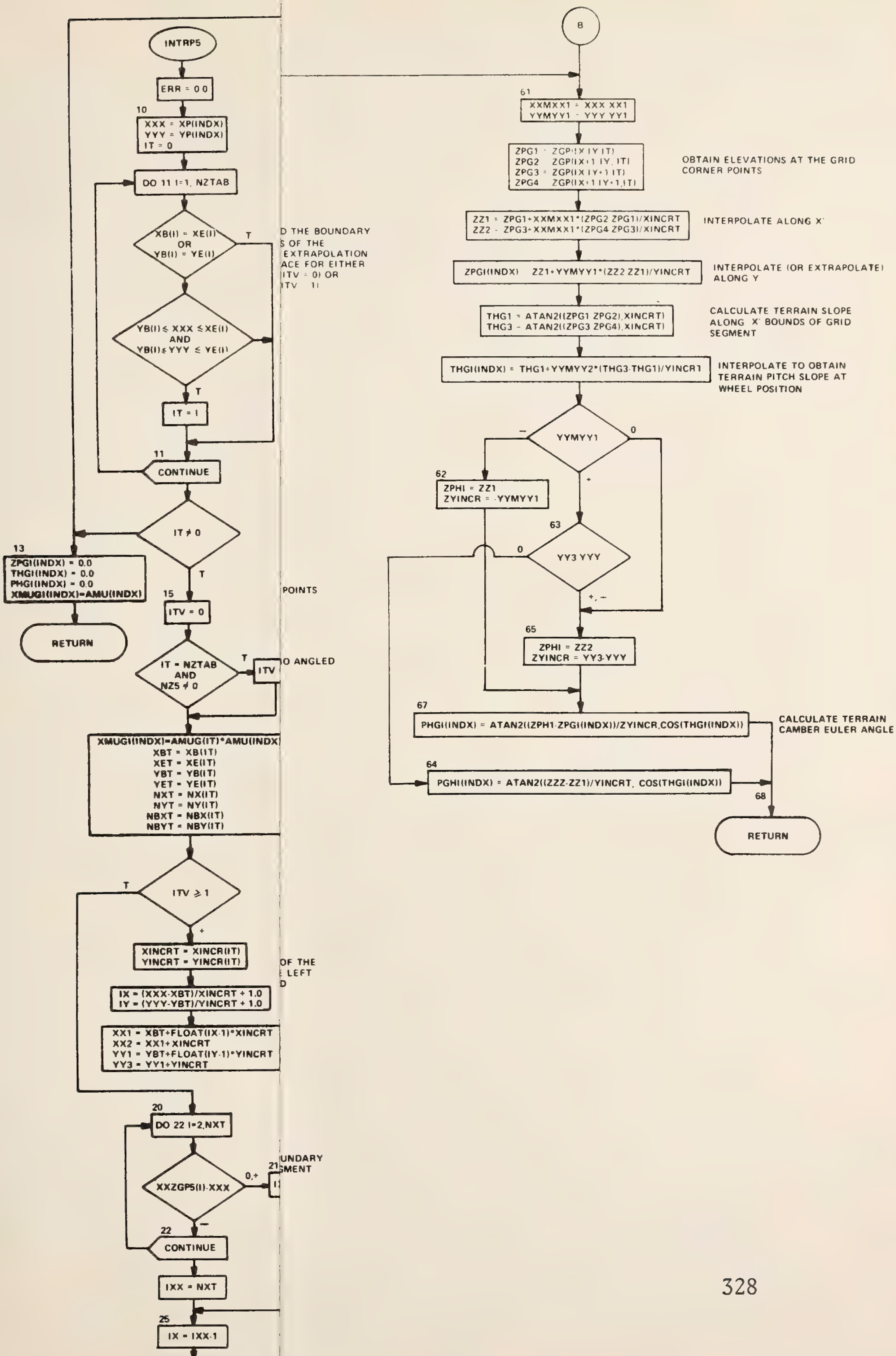
e. Common Variables Calculated:

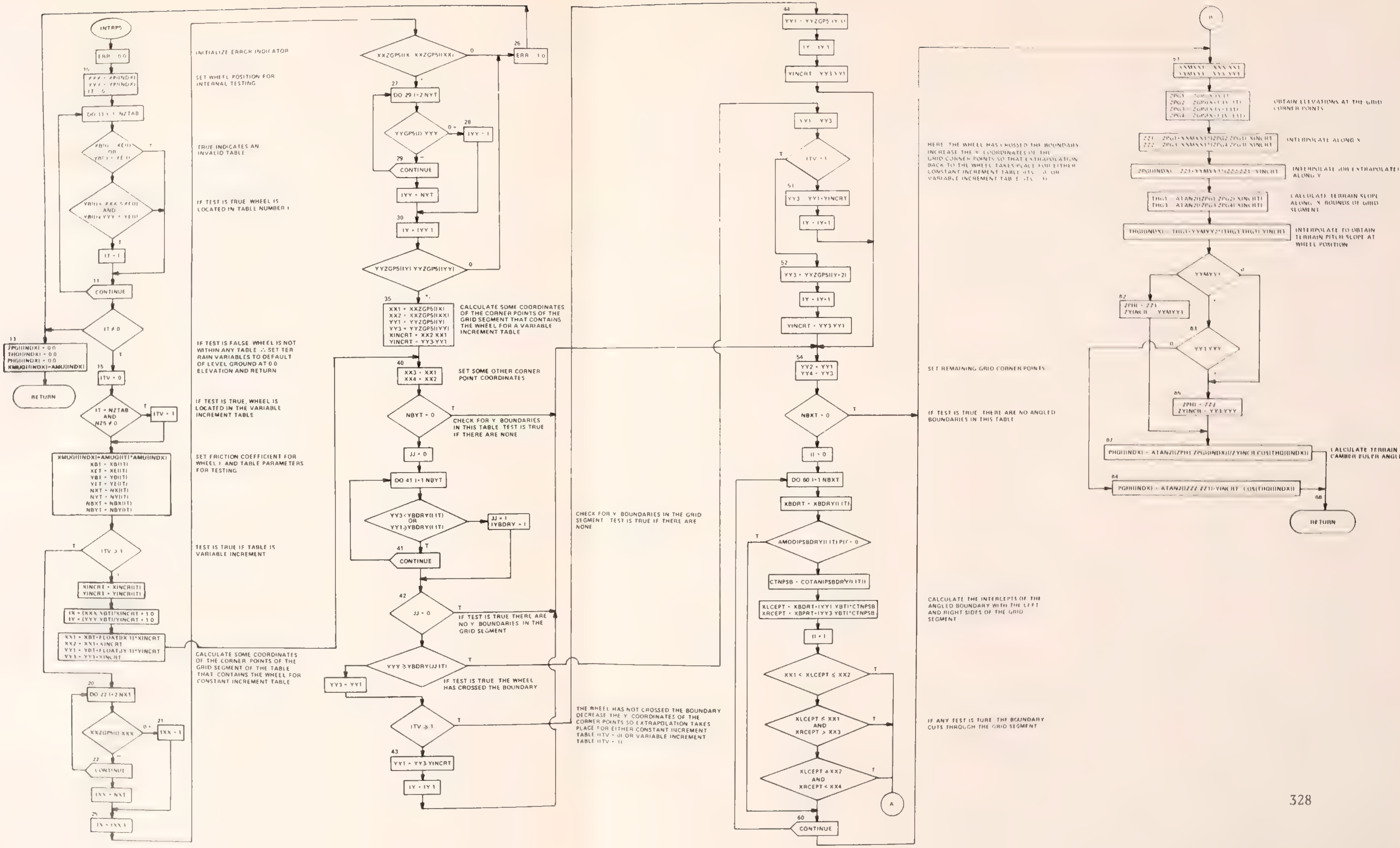
IX, IY, PHG1, THG1, THG1, XMUG1, XXX, XX1, XX2, YYY, YY1, YY2, ZPG1

f. Size:

$129C)_{16} = 4764)_{10}$ bytes

g. Computational Procedure:


INTRP5
ERR = 0.0
10
XXX = XP(INDX)
YYY = YP(INDX)
IT = 0
DO 11 I=1, NZTAB
XB(I) = XE(I)
OR
YB(I) = YE(I)
T
YB(I) ≤ XXX ≤ XE(I)
AND
YB(I) ≤ YYY ≤ YE(I)
IT = I
11
CONTINUE
IT ≠ 0
13
ZPGI(INDX) = 0.0
THGI(INDX) = 0.0
PHGI(INDX) = 0.0
XMUGI(INDX)=AMU(INDX)
RETURN
15
ITV = 0
IT = NZTAB
AND
NZ5 ≠ 0
ITV
XMUGI(INDX)=AMUG(IT)*AMU(INDX)
XBT = XB(IT)
XET = XE(IT)
YBT = YB(IT)
YET = YE(IT)
NXT = NX(IT)
NYT = NY(IT)
NBXT = NBX(IT)
NBYT = NBY(IT)
ITV ≥ 1
XINCRT = XINCR(IT)
YINCRT = YINCR(IT)
IX = (XXX-XBT)/XINCRT + 1.0
IY = (YYY-YBT)/YINCRT + 1.0
XX1 = XBT+FLOAT(IX-1)*XINCRT
XX2 = XX1+XINCRT
YY1 = YBT+FLOAT(IY-1)*YINCRT
YY3 = YY1+YINCRT
20
DO 22 I=2,NXT
XXZGP5(I)-XXX
0,+
22
CONTINUE
IXX = NXT
25
IX = IXX-1
D THE BOUNDARY
S OF THE
EXTRAPOLATION
ACE FOR EITHER
(ITV = 0) OR
ITV = 1)
POINTS
O ANGLED
OF THE
LEFT
UNDARY
GMENT
B
61
XXMXX1 = XXX-XX1
YYMYY1 = YYY-YY1
ZPG1 = ZGP(IX,IY,IT)
ZPG2 = ZGP(IX+1,IY,IT)
ZPG3 = ZGP(IX,IY+1,IT)
ZPG4 = ZGP(IX+1,IY+1,IT)
OBTAIN ELEVATIONS AT THE GRID
CORNER POINTS
ZZ1 = ZPG1+XXMXX1*(ZPG2-ZPG1)/XINCRT
ZZ2 = ZPG3+XXMXX1*(ZPG4-ZPG3)/XINCRT
INTERPOLATE ALONG X'
ZPGI(INDX) = ZZ1+YYMYY1*(ZZ2-ZZ1)/YINCRT
INTERPOLATE (OR EXTRAPOLATE)
ALONG Y
THG1 = ATAN2((ZPG1-ZPG2),XINCRT)
THG3 = ATAN2((ZPG3-ZPG4),XINCRT)
CALCULATE TERRAIN SLOPE
ALONG X' BOUNDS OF GRID
SEGMENT
THGI(INDX) = THG1+YYMYY2*(THG3-THG1)/YINCRT
INTERPOLATE TO OBTAIN
TERRAIN PITCH SLOPE AT
WHEEL POSITION
YYMYY1
62
ZPHI = ZZ1
ZYINCR = -YYMYY1
63
YY3-YYY
65
ZPHI = ZZ2
ZYINCR = YY3-YYY
67
PHGI(INDX) = ATAN2((ZPHI-ZPGI(INDX))/ZYINCR,COS(THGI(INDX)))
CALCULATE TERRAIN
CAMBER EULER ANGLE
64
PGHI(INDX) = ATAN2((ZZZ-ZZ1)/YINCRT, COS(THGI(INDX)))
68
RETURN


INTRPS
INITIALIZE ERROR INDICATOR
SET WHEEL POSITION FOR INTERNAL TESTING
TRUE INDICATES AN INVALID TABLE
IF TEST IS TRUE WHEEL IS LOCATED IN TABLE NUMBER I
CONTINUE
RETURN
IF TEST IS FALSE WHEEL IS NOT WITHIN ANY TABLE ∴ SET TERRAIN VARIABLES TO DEFAULT OF LEVEL GROUND AT 0.0 ELEVATION AND RETURN
IF TEST IS TRUE, WHEEL IS LOCATED IN THE VARIABLE INCREMENT TABLE
SET FRICTION COEFFICIENT FOR WHEEL I AND TABLE PARAMETERS FOR TESTING
TEST IS TRUE IF TABLE IS VARIABLE INCREMENT
CALCULATE SOME COORDINATES OF THE CORNER POINTS OF THE GRID SEGMENT OF THE TABLE THAT CONTAINS THE WHEEL FOR CONSTANT INCREMENT TABLE
CALCULATE SOME COORDINATES OF THE CORNER POINTS OF THE GRID SEGMENT THAT CONTAINS THE WHEEL FOR A VARIABLE INCREMENT TABLE
SET SOME OTHER CORNER POINT COORDINATES
CHECK FOR Y BOUNDARIES IN THIS TABLE. TEST IS TRUE IF THERE ARE NONE
IF TEST IS TRUE THERE ARE NO Y BOUNDARIES IN THE GRID SEGMENT
IF TEST IS TRUE THE WHEEL HAS CROSSED THE BOUNDARY
CHECK FOR Y BOUNDARIES IN THE GRID SEGMENT. TEST IS TRUE IF THERE ARE NONE
THE WHEEL HAS NOT CROSSED THE BOUNDARY DECREASE THE Y COORDINATES OF THE CORNER POINTS SO EXTRAPOLATION TAKES PLACE FOR EITHER CONSTANT INCREMENT TABLE (ITV = 0) OR VARIABLE INCREMENT TABLE (ITV = 1)
HERE THE WHEEL HAS CROSSED THE BOUNDARY INCREASE THE Y COORDINATES OF THE GRID CORNER POINTS SO THAT EXTRAPOLATION BACK TO THE WHEEL TAKES PLACE FOR EITHER CONSTANT INCREMENT TABLE (ITV = 0) OR VARIABLE INCREMENT TABLE (ITV = 1)
SET REMAINING GRID CORNER POINTS
IF TEST IS TRUE THERE ARE NO ANGLED BOUNDARIES IN THIS TABLE
CALCULATE THE INTERCEPTS OF THE ANGLED BOUNDARY WITH THE LEFT AND RIGHT SIDES OF THE GRID SEGMENT
IF ANY TEST IS TURE THE BOUNDARY CUTS THROUGH THE GRID SEGMENT
OBTAIN ELEVATIONS AT THE GRID CORNER POINTS
INTERPOLATE ALONG X
INTERPOLATE (OR EXTRAPOLATE) ALONG Y
CALCULATE TERRAIN SLOPE ALONG X BOUNDS OF GRID SEGMENT
INTERPOLATE TO OBTAIN TERRAIN PITCH SLOPE AT WHEEL POSITION
CALCULATE TERRAIN CAMBER EULER ANGLE
RETURN

30. SUBROUTINE MATRIX

a. Purpose:

1. Evaluate the elements of the inertial matrix for the ten coupled degrees of freedom (DMATX(I,J), I = 1,10, J = 1,10) for the independent front/solid axle rear suspension option
2. Evaluate the forcing column matrix for the ten coupled degrees of freedom (DMATX(I,11), I = 1,10) for the independent front/solid rear axle option

b. Common Blocks Required:

INPT, INTG, DIMV, COMP, ADTNL

c. Subroutines Required:

CLEAR

d. Arguments:

None

e. Common Variables Calculated:

DMATX, GCTCP, GCTSP

f. Size:

$72C)_{16} = 1836)_{10}$ bytes

g. Computational Procedure:

1. Call CLEAR to zero the DMATX. This is necessary since the subroutine which decouples the equations of motion also destroys the DMATX in the process and may leave meaningless values in array elements which should be zero.
2. Calculate the elements of DMATX.

31. SUBROUTINE MTRXIR

a. Purpose:

1. Evaluate the elements of the inertial matrix for the ten coupled degrees of freedom (DMATX(I,J), I = 1,10, J = 1,10) for the independent rear suspension option
2. Evaluate the forcing column matrix for the ten coupled degrees of freedom (DMATX(I,11), I = 1,10) for the independent rear suspension option

b. Common Blocks Required:

INPT, INTG, DIMV, COMP, ADTNL, SUSCMP

c. Subroutines Required:

CLEAR

d. Arguments:

None

e. Common Variables Calculated:

DMATX, GCTCP, GCTSP

f. Size:

$4C0)_{16} = 1216)_{10}$ bytes

g. Computational Procedure:

1. Call CLEAR to zero the DMATX. This is necessary since the subroutine which decouples the equations of motion also destroys the DMATX in the process and may leave meaningless values in array elements which should be zero.
2. Calculate the elements of DMATX.

32. SUBROUTINE MTRXSF

a. Purpose:

1. Evaluate the elements of the inertial matrix for the ten coupled degrees of freedom (DMATX(I,J), I = 1,10, J = 1,10) for the solid front axle option
2. Evaluate the forcing column matrix for the ten coupled degrees of freedom (DMATX(I,11), I = 1,10) for the solid front axle option

b. Common Blocks Required:

INPT, INTG, DIMV, COMP, ADTNL, SUSCMP, INSUS

c. Subroutines Required:

CLEAR

d. Arguments:

None

e. Common Variables Calculated:

DMATX, GCTCP, GCTSP

f. Size:

$962)_{16} = 2402)_{10}$ bytes

g. Computational Procedure:

1. Call CLEAR to zero the DMATX. This is necessary since the subroutine which decouples the equations of motion also destroys the DMATX in the process and may leave meaningless values in array elements which should be zero
2. Calculate the elements of DMATX

33. SUBROUTINE OUTPUT(IND)

a. Purpose:

1. Print output page titles and output data

b. Common Blocks Required:

HEAD, INPT, INTG, DIMV, COMP, COMPN, ADTNL, INSUS, SUSCMP, BARSTR

c. Subroutines Required:

None

d. Arguments:

If IND = 0, an output line counter is initialized to zero.

e. Common Variables Calculated:

None

f. Size:

$40E0)_{16} = 16608)_{10}$ bytes

g. Computational Procedure:

Each time a call to this subroutine is executed, an output line of data is written to FORTRAN devices 11 through, at most, 29. The number of devices actually written to is dependent on the indicators contained in the NPAGE array. These indicators are set either by the user on input card 104 or by the program depending on the options in use.

On either the first call to the subroutine with IND $\neq$ 0 or after 50 lines of data have been written, page headings are written for each page of data.

An entry point, THPLOT, is provided to write static and dynamic data to FORTRAN device 3 for the purpose of subsequent plotting of time history data.

34. FUNCTION PARI(NN,IA, TSEC,X,Y)

a. Purpose:

1. Lagrangian interpolation

b. Common Blocks Required:

None

c. Subroutines Required:

None

d. Arguments:

NN - size of X and Y arrays
IA - subscript of first tabular point
TSEC - target value of the X dimension
X - array containing values of the abscissa
Y - array containing values of the ordinate

e. Common Variables Calculated:

None

f. Size:

$234)_{16} = 564)_{10}$ bytes

35. SUBROUTINE PINT1(IN, MODE, N, X, H, Y, YP, A)

a. Purpose:

1. To integrate a system of N ordinary differential equations of the first order

b. Common Blocks Required:

None

c. Subroutines Required:

DAUX

d. Arguments:

IN is the control word (= 1 or 2) for initialization or to integrate one step-size;

IN = 1 - to set up the routine for integration;
IN = 2 - to integrate one step-size;

MODE is the option word (= 0, 1 or 2) for using one of the three modes of integration. When MODE equals

0 - the Adams-Moulton variable step-size is used;
1 - the Runge-Kutta fixed step-size is used;
2 - the Adams-Moulton fixed step-size is used;

N is the number of first order differential equations;

X is the independent or source variable;

H is the step-size or increment in the source variable;

Y is the array of dependent or target variables updated by PINT1;

YP is the array of first derivatives of the target variables Y(N) computed in the subroutine DAUX;

A is an array of 6 cells containing the parameters ($\bar{E}, \bar{M}, \alpha, h_{max}, h_{min}, \beta$) needed for the variable mode only;

A(1) ($\equiv \bar{E}$) is an upper bound on the truncation error (the number of significant digits which the user desired to preserve locally) for the variable Adams-Moulton method, normally $10^{-8} < A(1) < 10^{-3}$;

A(2) ($\equiv \bar{M}$) is a positive number from which the lower bound on the truncation error is computed. In particular, when A(2) is zero the routine used the normal value of 100 and in all other cases the lower bound is computed as the quotient of A(1) by A(2);

A(3) (α) is a positive number used to prevent unnecessary reduction in the variable step-size when the dependent variables are sufficiently small. When A(3) is zero the routine uses the normal value of one;

A(4) (h_{max}) is a positive upper bound for the magnitude of the variable step-size. If A(4) is zero the routine assumes there is no upper bound;

A(5) ($\equiv h_{min}$) is positive lower bound for the magnitude of the variable step-size. The routine assumes there is no lower bound when A(5) is zero;

A(6) ($\equiv \beta$) is a positive number between zero and one used to increase or decrease the variable step-size. When A(6) is zero the routine assumes the value of one-half.

IN, N and MODE are integers while X, H, Y, YP and A are all single precision floating point numbers.

The arguments X, H, Y, YP, of the PINT1 calling sequence must be in a COMMON type statement.

Before executing the first PINT1 call, the user must initialize X, H and each of the Y(N) variables. The first call must use control word (IN = 1) to set up the routine for integration. The control word (IN = 2) may be used any number of times after the first to integrated one step-size, provided X, H and Y have not been redefined between integration steps.

e. Common Variables Calculated:

None

f. Size:

$1B2C)_{16} = 6956)_{10}$ bytes

g. Computational Procedure:

In this routine the user is allowed an option of using either the Runge-Kutta classical fourth-order method as modified by E. K. Blum or the Adams-Moulton predictor-corrector method using the Runge-Kutta method for starting the process.

Let the system of equations to be solved be given in the form

$$y_i = f_i\,(x, y_1, y_2, \cdots, y_N) \tag{1.1}$$

$$y_i\,(x_0) = y_{i0} \qquad i = 1, 2, \ldots, N$$

Let y_{in} be the value of y_i at $x = x_n$ and f_{in} the derivative of y_i at $x = x_n$. If h is the increment (step-size) of the independent variable x, the classical Runge-Kutta fourth-order method uses the formulas

$$K_{i1} = h f_i (x_n, y_{in})$$
$$K_{i2} = h f_i (x_n + 1/2 h, \; y_{in} + 1/2 \, K_{i1})$$
$$K_{i3} = h f_i (x_n + 1/2 h, \; y_{in} + 1/2 \, K_{i2}) \tag{1.2}$$
$$K_{i4} = h f_i (x_n + h, \; y_{in} + K_{i3})$$
$$y_{i,n+1} = y_{in} + 1/6 (K_{i1} + 2K_{i2} + 2K_{i3} + K_{i4})$$

where $i = 1, 2, \ldots N$

The E. K. Blum Modification:

The following recursive form of the E. K. Blum's exact modification of the Runge-Kutta is used in this routine:

$$\begin{cases} z_0 = y_n \\ q_0 = y_n & \text{at } x = x_0 \\ p_0 = h f(z_0) \end{cases} \tag{2.1}$$

$$\begin{cases} z_1 = z_0 + p_0/2 \\ q_1 = p_0 & \text{at } x = x_0 + h/2 \\ p_1 = h f(z_1) \end{cases} \tag{2.2}$$

$$\begin{cases} z_2 = z_1 + p_1/2 - q_1/2 \\ q_2 = q_1/6 & \text{at } x = x_0 + h/2 \\ p_2 = h f(z_2) - p_1/2 \end{cases} \tag{2.3}$$

$$\begin{cases} z_3 = z_2 + p_2 \\ q_3 = q_2 + p_2 \\ p_3 = h f(z_3) + 2p_2 \end{cases} \tag{2.4}$$

$$y_{i,n+1} \equiv z_4 = z_3 + q_3 + p_3/6 \tag{2.5}$$

(we omit the subscript i from each of the vectors z_j, q_j and p_j for reasons of economy)

The main advantage of the modified Runge-Kutta formulas is that they reduce considerably the rounding error arising from the unavoidable use of digital numbers and pseudo-operations.

Adams-Moulton Predictor-Corrector Method:

The routine uses the following formulas for the system (1. 1):

$$y_{i,n+1}^{[P]} = y_{i,n} + h/24(55f_{i,n} - 59f_{i,n-1} + 37f_{i,n-2} - 9f_{i,n-3}) \quad (3.1)$$

$$y_{i,n+1} = y_{i,n+1}^{[C]} = y_{i,n} + h/24(9f_{i,n+1}^{[P]} + 19f_{i,n} - 5f_{i,n-1} + f_{i,n-2}) \quad (3.2)$$

The starting values needed in the predictor formula (3. 1) are obtained using the Runge-Kutta-Blum (RKB) method. In the evaluation of y_i at $x = x_{n+1}$ the predictor and corector formulas are applied only once so that only two derivative evaluations ($f_{i,n+1}^{[P]}$ and $f_{i,n}$) are needed for each Adams-Moulton (variable or fixed step-size) integration step.

The Variable Adams-Moulton:

The step-size h to be used in the variable mode is determined mainly by:

$$E_{n+1} = \underset{i}{MAX} \frac{y_{i,n+1}^{[P]} - y_{i,n+1}^{[C]}}{14 D_i} \quad (3.3)$$

$$D_i = \underset{i}{MAX} \quad y_{i,n+1}^{[C]}, \ \alpha \qquad , i = 1, 2, \ldots, N$$

where

E_{n+1} is the local truncation error estimate in the actual evaluation of y_{n+1} ; α (> 0) is a constant used to prevent unnecessary reductions in $|h|$ whenever $|y_{i,n+1}|$ is small (normally the routine will set $\alpha = 1$, unless otherwise specified by the user).

Let

$\bar{E}$ be the upper bound on the truncation error estimate, specified by the user, that is the number of significant digits which the user desires to preserve locally throughout the integration. Normally $\bar{E}$ should be in the range $10^{-8} \leq \bar{E} \leq 10^{-3}$ and in double precision $\bar{E}$ should be in the range $10^{-16} \leq \bar{E} \leq 15^{12}$;

M (> 0) be a constant, specified by the user, from which a lower bound $\underline{E} = M^{-1}\bar{E}$ is obtained (normally M range from 50 to 150 and in double precision from 1000 to 1500);

β be a constant between 0 to 1 used to increase or decrease the step-size. The routine will take β = 1/2 unless β is otherwise specified by the user.

The step-size h will be then increased or decreased according to the following inequalities:

If

(4.1)	$E_{n+1} > \bar{E}$	the step-size is reduced to βh, where $0 < \beta < 1$;
(4.2)	$M^{-1}\bar{E} < E_{n+1} < \bar{E}$	the step-size remains unchanged;
(4.3)	$E_{n+1} < M^{-1}\bar{E}$	for 3 successive integration steps the step-size is increased to h/β.

Increasing and Decreasing the Step-Size:

The starting values, the first three successive points after the initial point p_0, for the Adams-Moulton formulas are always obtained using the RKB method whenever the interval size is changed, just as at the beginning of an integration.

In the variable mode if the starting values, the first three successive points, have been obtained using the RKB method then the next point is computed using the Adams-Mouton predictor-corrector formulas (3.1) and (3.2). Whenever the truncation error at this point calls for a decrease in h the routine returns to the initial point p_0 and computes new starting values with the decreased value of h. However, if the step-size is to be decreased at a point p_i, where the preceeding point p_{i-1} was computed in the variable mode and the inequality (4.2) held at p_{i-1}, then a new start is initiated at p_{i-1} with decreased value of $|h|$.

If for three successive variable integration steps p_{i-1}, p_i and p_{i+1} inequality (4.3) holds, then a new start is initiated at p_{i+1} with the increased value of $|h|$. After an interval is increased, the routine prevents increasing again until 6 more points have been complete. However, the routine may decrease the interval as often as necessary. The truncation error test based on (3.3) will guarantee that the local error does not exceed $\bar{E}$, however the cumulative error will usually exceed $\bar{E}$. Hence $\bar{E}$ should be chosen sufficiently small to allow for an accumulation of truncation error.

The user must always provide a starting value for h and he may, if desired, specify a maximum value of $|h|$, h_{max} beyond which the routine will not increase $|h|$ and a minimum value of $|h|$, h_{min}, below which it will not decrease . If no value is specified for h_{max} and h_{min} the routine will set the values at 10^3 and 10^{-17}, respectively.

Negative values of h may be used for backward integration.

Control and DAUX:

There are two entries to this routine. The first (control word = 1) must be used once at the beginning to set up the routine for integration of a given set of N differential equations. The second entry (control word = 2) may be used any number of times after the first to integrate all y_i from x to $x+h$.

Whenever the control word is 1 the routine uses the auxiliary subroutine DAUX to evaluate the derivatives at the initial point $x = x_0$ and returns with all y_i unchanged. The routine also checks and sets up the six parameter words $\bar{E}$, M, α, h_{max}, h_{min} and β needed in the variable mode of operation. Before executing the initialization entry, the user must have already set up the appropriate values for x, h and y_i $i = 1, 2, \ldots N$. Ordinarily, after an execution of the second entry all y_i assume new values, x will have been advanced to the value $x+h$ and h will be unchanged, unless in the variable mode. On exit the values y_i are always these which correspond to the point $x+h$ and y_i.

Whenever an integration step involves RKB integration, four derivative evaluations are needed, mainly

$$
\begin{aligned}
&f_i(x_n + 1/2\,h,\ y_{in} + 1/2\,K_{i1}) \\
&f_i(x_n + 1/2\,h,\ y_{in} + 1/2\,K_{i2}) \\
&f_i(x_n + h,\ y_{in} + K_{i3}) \\
&y_{i,n+1} = f_i(x_n + h,\ y_{n+1})
\end{aligned}
\tag{5.1}
$$

where the K_{ij} are given by (1.2) and modified by (2.1), [illegible]. In the fixed predictor-corrector mode, the first three integration entries involve RKB integration and subsequent ones involve AM integration. Each AM integration step requires two derivative evaluations.

$$
\begin{aligned}
f_{i,n+1}^{[P]} &= f_i(x_n + h,\ y_{i,n+1}^{[P]}) \\
y'_{i,n+1} &= f_i(x_n + h,\ y_{n+1})
\end{aligned}
\tag{5.2}
$$

A particular integration set up, in the variable mode, may involve either AM or RKB or both.

References:

(1) SHARE Write-Up No. 0602 (D2RWINT)
(2) SHARE Write-Up No. 0450 (D2RDE2F)
(3) Blum, K. E., A Modification of the Runge-Kutta Fourth Order Method, Mathematics of Computation, April 1962, pp. 176-187

36. SUBROUTINE PLOTTP(IPLT)

a. Purpose:

1. Write output to FORTRAN device 1 for post-processing graphic displays

b. Common Blocks Required:

INPT, INTG, DIMV, COMP, COMPN, TIRIN

c. Subroutines Required:

None

d. Arguments:

IPLT controls the type of record written; static, dynamic or end of data, for values of IPLT of 1, 2 and 3, respectively

e. Common Variables Calculated:

None

f. Size:

$324)_{16} = 804)_{10}$ bytes

g. Computational Procedure:

1. If IPLT = 1 a static header record is written to device 1 consisting of the following variables: HED, DADE, A, B, TS, ZR, RHO, ZF, RW, TF, TR
2. If IPLT = 2 a dynamic record is written consisting of: T, XCP, YCP, ZCP, PHIT, THETT, PSIT, DEL1, DEL2, DEL3, PHIR, PSI1, PHI2, (XGPP(I), YGPP(I), ZGPP(I), I = 1,4), (ICONTW(I), I = 1,4) .
   Note: ICONTW is an indicator. If 1, wheel I is rolling; if -1, wheel I is skidding; if 0, wheel I is off the ground.
3. If IPLT = 3, an end of data record consisting of 30 words of -9999.0 is written.

37. SUBROUTINE RUFFRC(I,ZGM)

a. Purpose:

1. To determine an equival
contact point from the
when the road roughness

b. Common Blocks Required:

INPT1, DIMV, COMP, COMPN, T

c. Subroutines Required:

INTRPL

d. Arguments:

I = wheel number for whic
ZGM = single dimensioned ar
roughness data

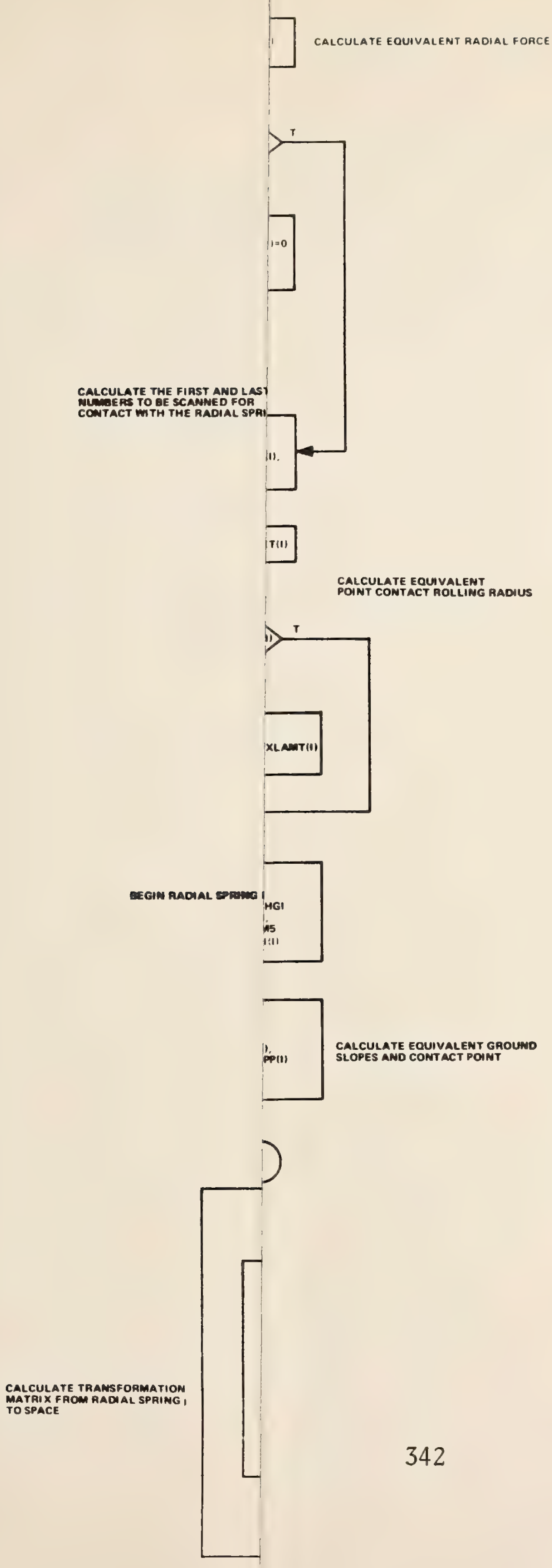
e. Common Variables Calculated

FR, HI, CAR, CBR, CGR, CPG,
PHGI, SFRX, SFRY, SFRZ, XGP

f. Size:

$DC4)_{16} = 3524)_{10}$ bytes

g. Computational Procedure:


CALCULATE EQUIVALENT RADIAL FORCE
T
)=0
CALCULATE THE FIRST AND LAST
NUMBERS TO BE SCANNED FOR
CONTACT WITH THE RADIAL SPRI
(I).
T(I)
CALCULATE EQUIVALENT
POINT CONTACT ROLLING RADIUS
T
XLAMT(I)
BEGIN RADIAL SPRING
HGI
M5
),
PP(I)
CALCULATE EQUIVALENT GROUND
SLOPES AND CONTACT POINT
CALCULATE TRANSFORMATION
MATRIX FROM RADIAL SPRING
TO SPACE

37. SUBROUTINE RUFFRC(I,ZGM)

a. Purpose:

1. To determine an equivalent radial tire force and ground contact point from the distributed tire spring model when the road roughness option is being used

b. Common Blocks Required:

INPT1, DIMV, COMP, COMPN, TIRIN, RUFNES

c. Subroutines Required:

INTRPL

d. Arguments:

I = wheel number for which calculations are made
ZGM = single dimensioned array containing the road roughness data

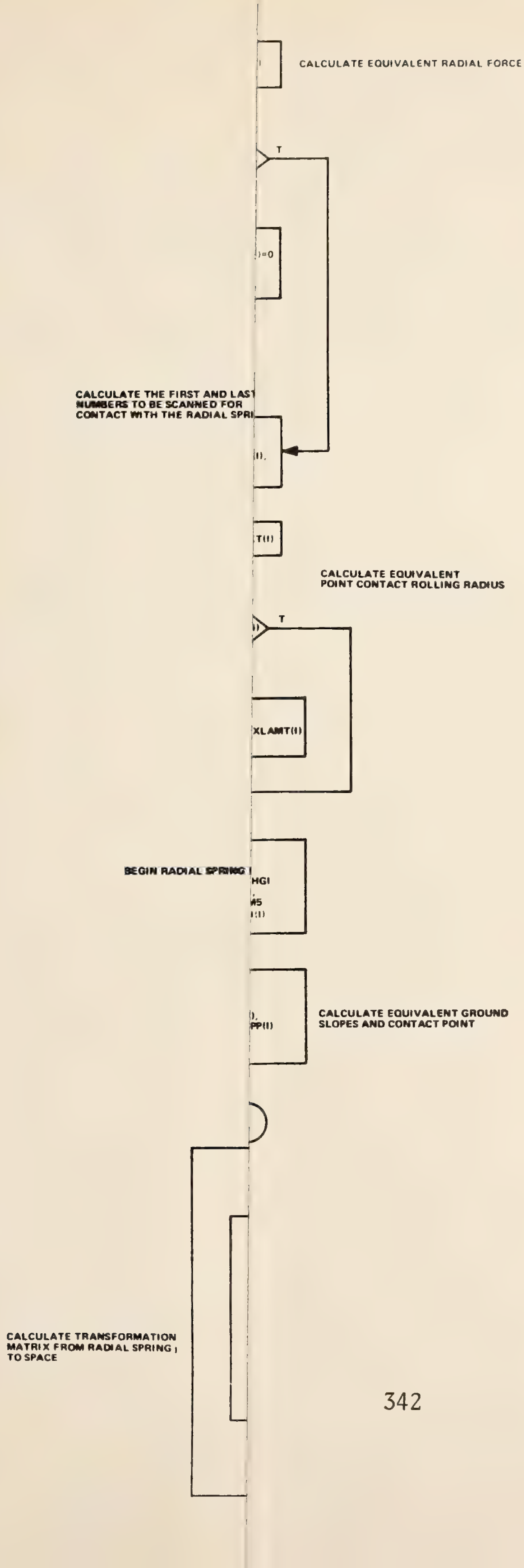
e. Common Variables Calculated:

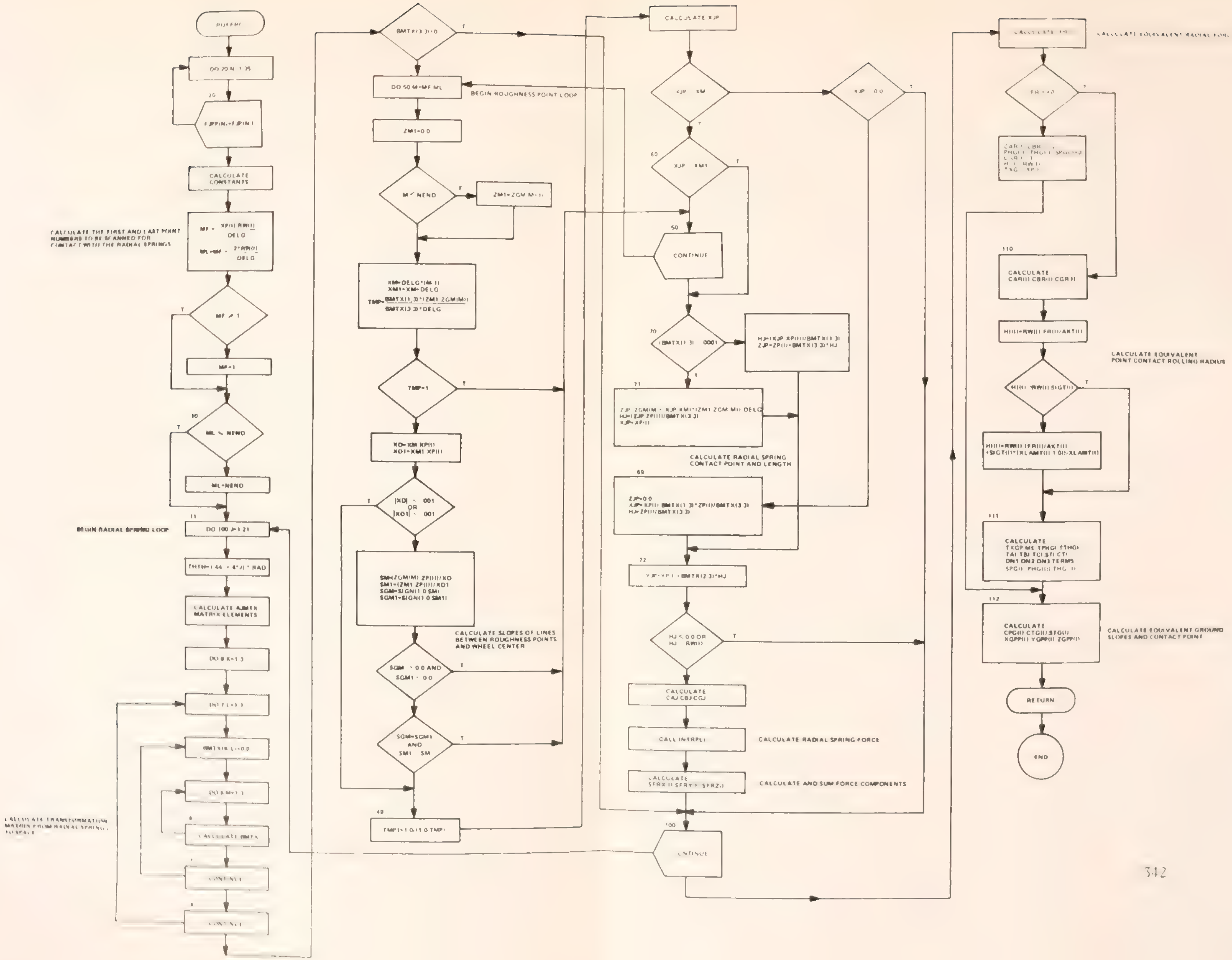
FR, HI, CAR, CBR, CGR, CPG, CTG, SPG, STG, BMTX, PHGI, SFRX, SFRY, SFRZ, XGPP, YGPP, ZGPP, AJMTX

f. Size:

$DC4)_{16} = 3524)_{10}$ bytes

g. Computational Procedure:


CALCULATE EQUIVALENT RADIAL FORCE
T
CALCULATE THE FIRST AND LAST
NUMBERS TO BE SCANNED FOR
CONTACT WITH THE RADIAL SPRI
CALCULATE EQUIVALENT
POINT CONTACT ROLLING RADIUS
T
XLAMT(I)
BEGIN RADIAL SPRING
CALCULATE EQUIVALENT GROUND
SLOPES AND CONTACT POINT
CALCULATE TRANSFORMATION
MATRIX FROM RADIAL SPRING
TO SPACE


CALCULATE THE FIRST AND LAST POINT NUMBERS TO BE SCANNED FOR CONTACT WITH THE RADIAL SPRINGS
BEGIN RADIAL SPRING LOOP
BEGIN ROUGHNESS POINT LOOP
CALCULATE SLOPES OF LINES BETWEEN ROUGHNESS POINTS AND WHEEL CENTER
CALCULATE RADIAL SPRING CONTACT POINT AND LENGTH
CALCULATE RADIAL SPRING FORCE
CALCULATE AND SUM FORCE COMPONENTS
CALCULATE EQUIVALENT POINT CONTACT ROLLING RADIUS
CALCULATE EQUIVALENT GROUND SLOPES AND CONTACT POINT
CALCULATE CONSTANTS
CALCULATE XJP
CONTINUE
RETURN
END

38. SUBROUTINE RUFRED(NEND,DELG,DGMAX,ZRTAB)

a. Purpose:

1. Read road roughness data from FORTRAN device 4

b. Common Blocks Required:

None

c. Subroutine Required:

None

d. Arguments:

NEND = the number of road roughness points to be read from FORTRAN unit 4
DELG = the distance increment between points
DGMAX = (NEND-1) * DELG
ZRTAB = a single dimension array into which the road roughness data is read

e. Common Variables Calculated:

None

f. Size:

$2B8)_{16} = 696)_{10}$ bytes

g. Computational Procedure:

The road roughness data is rear via an unformatted READ statement into the ZRTAB array. The maximum number of points allowed is 2200.

39. SUBROUTINE SIMSOL

a. Purpose:

This subroutine solves a set of real simultaneous linear algebraic equations AX = B, with input, output and internal computation all in single precision

b. Common Blocks Required:

None

c. Subroutines Required:

None

d. Arguments:

A - is a 2-dimensional (ND1xND2) matrix of coefficients
N - is the number of equations and unknowns
ND1 - is the first dimension of A in the calling program (ND1. GE. N and ND2. GE. N+1)

e. Common Variables Calculated:

None

f. Size:

$5E8)_{16} = 1512)_{10}$ bytes

g. Computational Procedure:

The routine will find the solution X of AX = B where A is a N by N matrix and B(I) is stored in A(I, N+1).
The solution X(I) is returned in A(I, N+1).

Note: The Matrix A is destroyed by the subroutine.

```
Example:  REAL A(20,25)
          CALL SIMSOL(A,10,20)
```

The solution is obtained by elimination using the largest pivotal divisor of each column. Each stage of elimination consists of interchanging rows when necessary to avoid division by zero or small numbers.

The forward solution to obtain variable N is done in N stages. The back solution for the other variables is calculated by successive substitutions. The final solution values are developed in column N+1 of matrix A, with variable 1 and A (1, N+1), variable 2 in A (2, N+1),..., and variable N in A (N, N+1).

38. SUBROUTINE RUFRED(NEND,DELG,DGMAX,ZRTAB)

a. Purpose:

1. Read road roughness data from FORTRAN device 4

b. Common Blocks Required:

None

c. Subroutine Required:

None

d. Arguments:

NEND = the number of road roughness points to be read from FORTRAN unit 4
DELG = the distance increment between points
DGMAX = (NEND-1) * DELG
ZRTAB = a single dimension array into which the road roughness data is read

e. Common Variables Calculated:

None

f. Size:

$2B8)_{16} = 696)_{10}$ bytes

g. Computational Procedure:

The road roughness data is rear via an unformatted READ statement into the ZRTAB array. The maximum number of points allowed is 2200.

39. SUBROUTINE SIMSOL

a. Purpose:

This subroutine solves a set of real simultaneous linear algebraic equations AX = B, with input, output and internal computation all in single precision

b. Common Blocks Required:

None

c. Subroutines Required:

None

d. Arguments:

A - is a 2-dimensional (ND1xND2) matrix of coefficients
N - is the number of equations and unknowns
ND1 - is the first dimension of A in the calling program (ND1. GE. N and ND2. GE. N+1)

e. Common Variables Calculated:

None

f. Size:

$5E8)_{16} = 1512)_{10}$ bytes

g. Computational Procedure:

The routine will find the solution X of AX = B where A is a N by N matrix and B(I) is stored in A(I, N+1).
The solution X(I) is returned in A(I, N+1).

Note: The Matrix A is destroyed by the subroutine.

```
Example:  REAL A(20,25)
          CALL SIMSOL(A,10,20)
```

The solution is obtained by elimination using the largest pivotal divisor of each column. Each stage of elimination consists of interchanging rows when necessary to avoid division by zero or small numbers.

The forward solution to obtain variable N is done in N stages. The back solution for the other variables is calculated by successive substitutions. The final solution values are developed in column N+1 of matrix A, with variable 1 and A (1, N+1), variable 2 in A (2, N+1),..., and variable N in A (N, N+1).

40. SUBROUTINE SUSFRC(DISP,VEL)

a. Purpose:

1. This subroutine calculates between the sprung and uns corners

b. Common Blocks Required:

INPT, INPT3, INTG, DIMV, COMP, INSUS, SUSCMP

c. Subroutines Required:

INTRPL

d. Arguments:

DISP - a four element array co displacements

VEL - a four element array co velocities

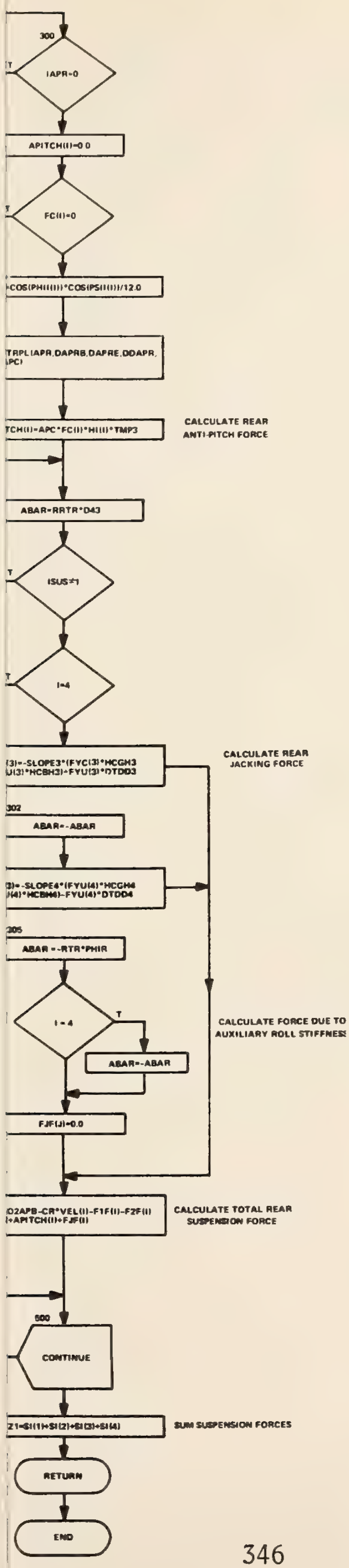
e. Common Variables Calculated:

SI, FJF, F1I, F2I, SFZ1, APITC

f. Size:

$7BC)_{16} = 1980)_{10}$ bytes

g. Computational Procedure:



300
IAPR=0
APITCH(I)=0.0
FC(I)=0
CALCULATE REAR ANTI-PITCH FORCE
ABAR=RRTR*D43
ISUS≠1
I=4
CALCULATE REAR JACKING FORCE
302
ABAR=-ABAR
305
ABAR =-RTR*PHIR
I = 4
ABAR=-ABAR
CALCULATE FORCE DUE TO AUXILIARY ROLL STIFFNES
FJF(J)=0.0
CALCULATE TOTAL REAR SUSPENSION FORCE
500
CONTINUE
SUM SUSPENSION FORCES
RETURN
END

40. SUBROUTINE SUSFRC(DISP,VEL)

a. Purpose:

1. This subroutine calculates the suspension forces acting between the sprung and unsprung masses at the four vehicle corners

b. Common Blocks Required:

INPT, INPT3, INTG, DIMV, COMP, ADTNL, APTABL, INSUS, SUSCMP

c. Subroutines Required:

INTRPL

d. Arguments:

DISP - a four element array containing the suspension displacements
VEL - a four element array containing the suspension velocities

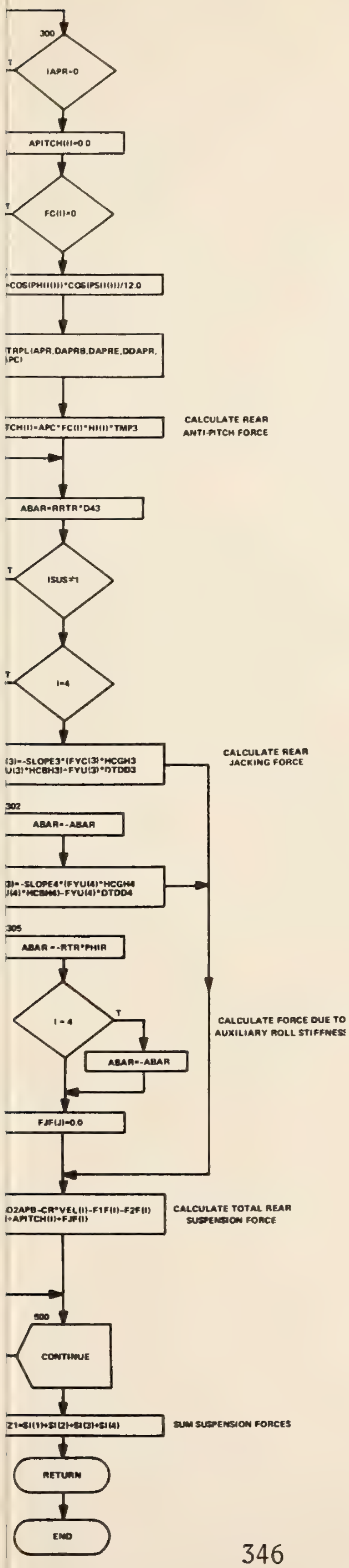
e. Common Variables Calculated:

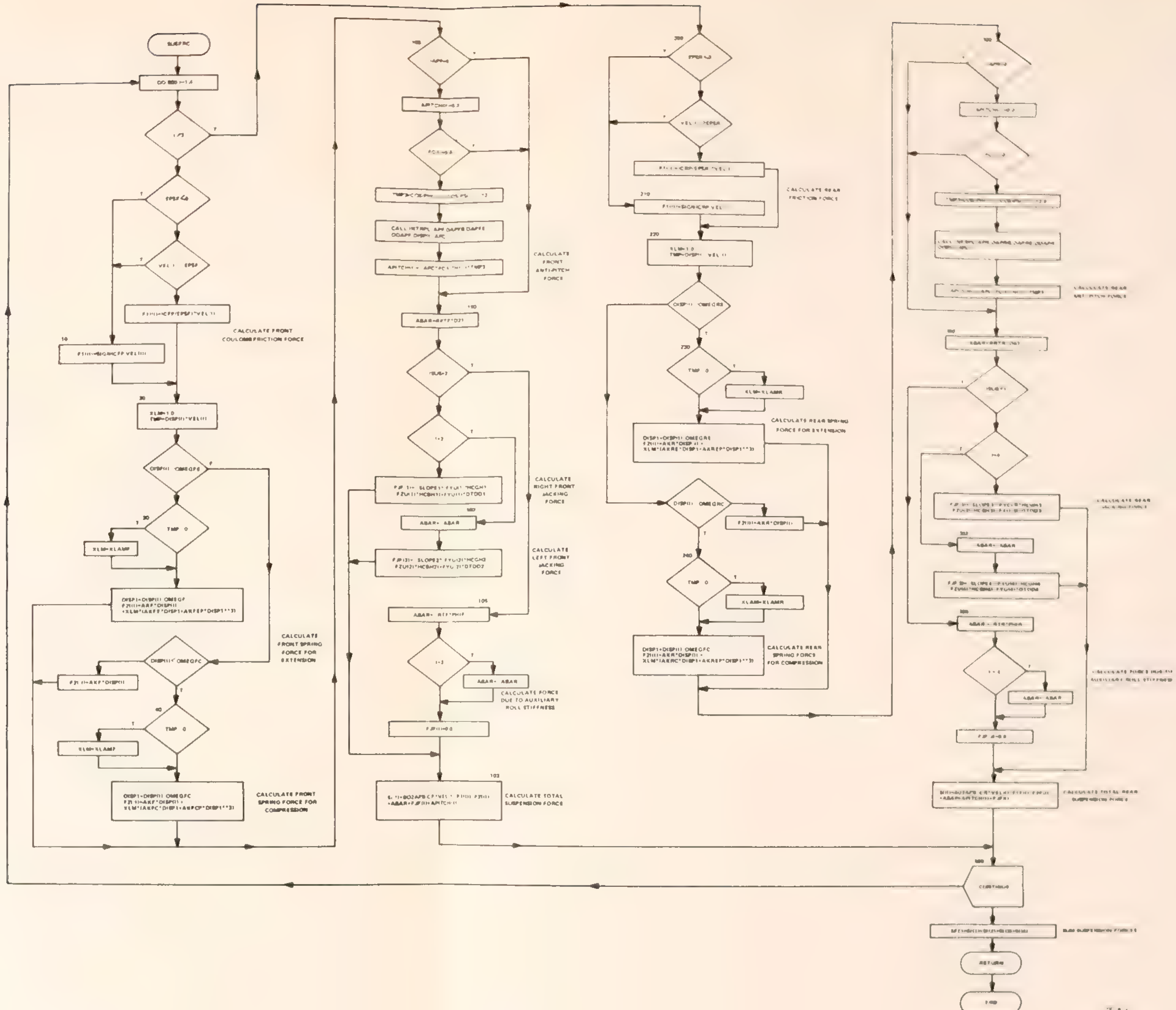
SI, FJF, F1I, F2I, SFZ1, APITCH

f. Size:

$7BC)_{16} = 1980)_{10}$ bytes

g. Computational Procedure:


300
IAPR=0
APITCH(I)=0.0
FC(I)=0
=COS(PHI(I(I)))*COS(PSI(I(I)))/12.0
TRPL(APR,DAPRB,DAPRE,DDAPR,
APC)
TCH(I)=APC*FC(I)*HI(I)*TMP3
CALCULATE REAR
ANTI-PITCH FORCE
ABAR=RRTR*D43
ISUS≠1
I=4
CALCULATE REAR
JACKING FORCE
302
ABAR=-ABAR
305
ABAR=-RTR*PHIR
I=4
ABAR=-ABAR
CALCULATE FORCE DUE TO
AUXILIARY ROLL STIFFNES
FJF(J)=0.0
CALCULATE TOTAL REAR
SUSPENSION FORCE
500
CONTINUE
SUM SUSPENSION FORCES
RETURN
END


CALCULATE FRONT COULOMB FRICTION FORCE
CALCULATE FRONT SPRING FORCE FOR EXTENSION
CALCULATE FRONT SPRING FORCE FOR COMPRESSION
CALCULATE FRONT ANTI-PITCH FORCE
CALCULATE RIGHT FRONT JACKING FORCE
CALCULATE LEFT FRONT JACKING FORCE
CALCULATE FORCE DUE TO AUXILIARY ROLL STIFFNESS
CALCULATE TOTAL SUSPENSION FORCE
CALCULATE REAR FRICTION FORCE
CALCULATE REAR SPRING FORCE FOR EXTENSION
CALCULATE REAR SPRING FORCE FOR COMPRESSION

41. SUBROUTINE TEREAD

a. Purpose:

1. This subroutine reads terrain table input cards

b. Common Blocks Required:

INPT

c. Subroutines Required:

None

d. Arguments:

I - Terrain table number
NNBX - Number of X' boundaries
NNBY - Number of Y' boundaries
NNX - Number of X' terrain entries
NNY - Number of Y' terrain entries
NZ5T - Indicator for variable increment table
NERR - Error indicator

e. Common Variables Calculated:

ZGP, XBDRY, YBDRY, PSBDRO, XXZGP5, YYZGP5

f. Size:

$626)_{16} = 1574)_{10}$ bytes

42. SUBROUTINE TIRFR

a. Purpose:

1. Control integration step-size for wheel spin degrees-of-freedom
2. Integrate wheel spin degrees-of-freedom
3. Calculate brake temperatures
4. Calculate time averages of tire forces over DT

b. Common Blocks Required:

INPT, INTG, DIMV, COMP, COMPN, INPT4, COMP4, INTR, INPT5, COMP5

c. Subroutines Required:

DAUXR

d. Arguments:

None

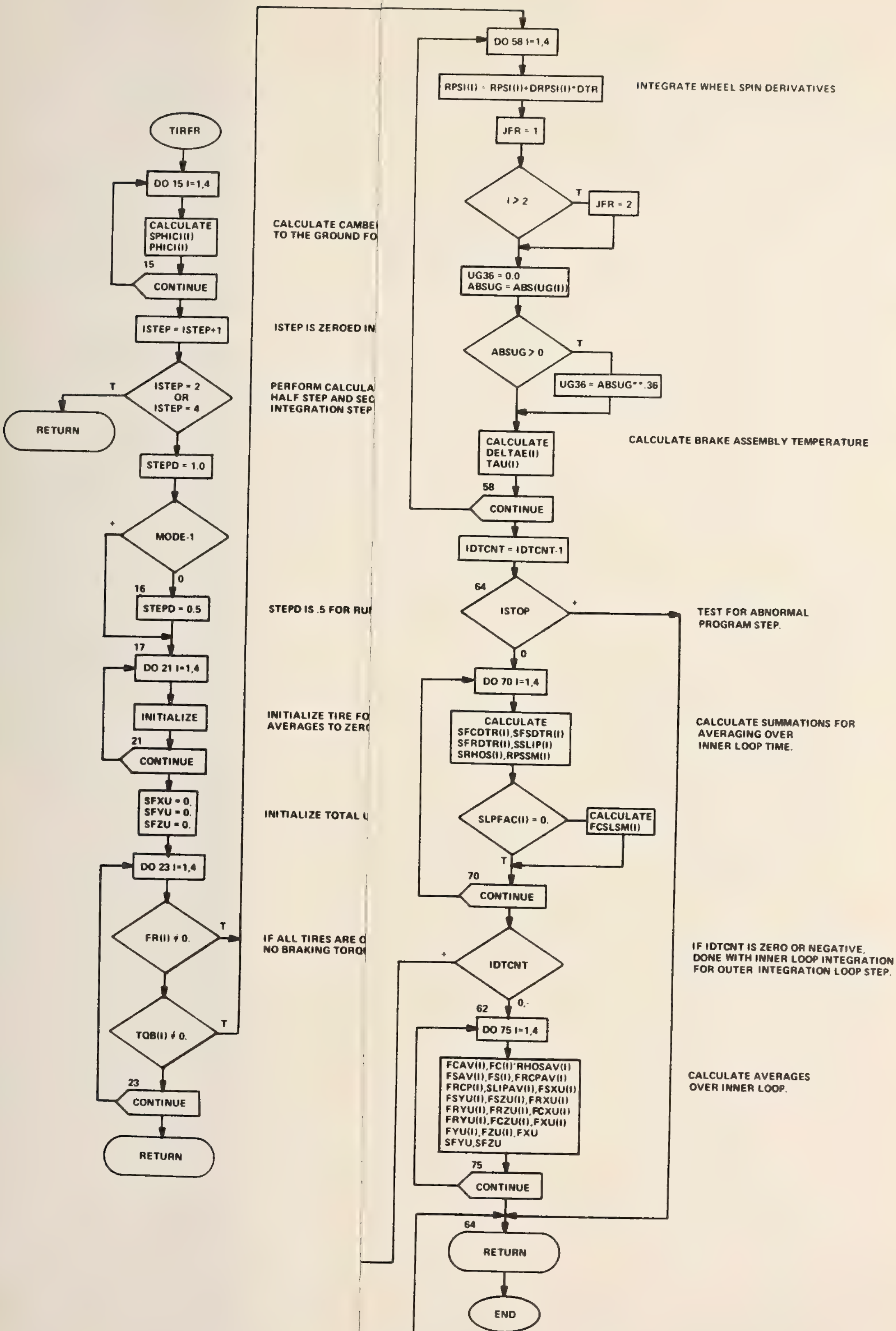
e. Common Variables Calculated:

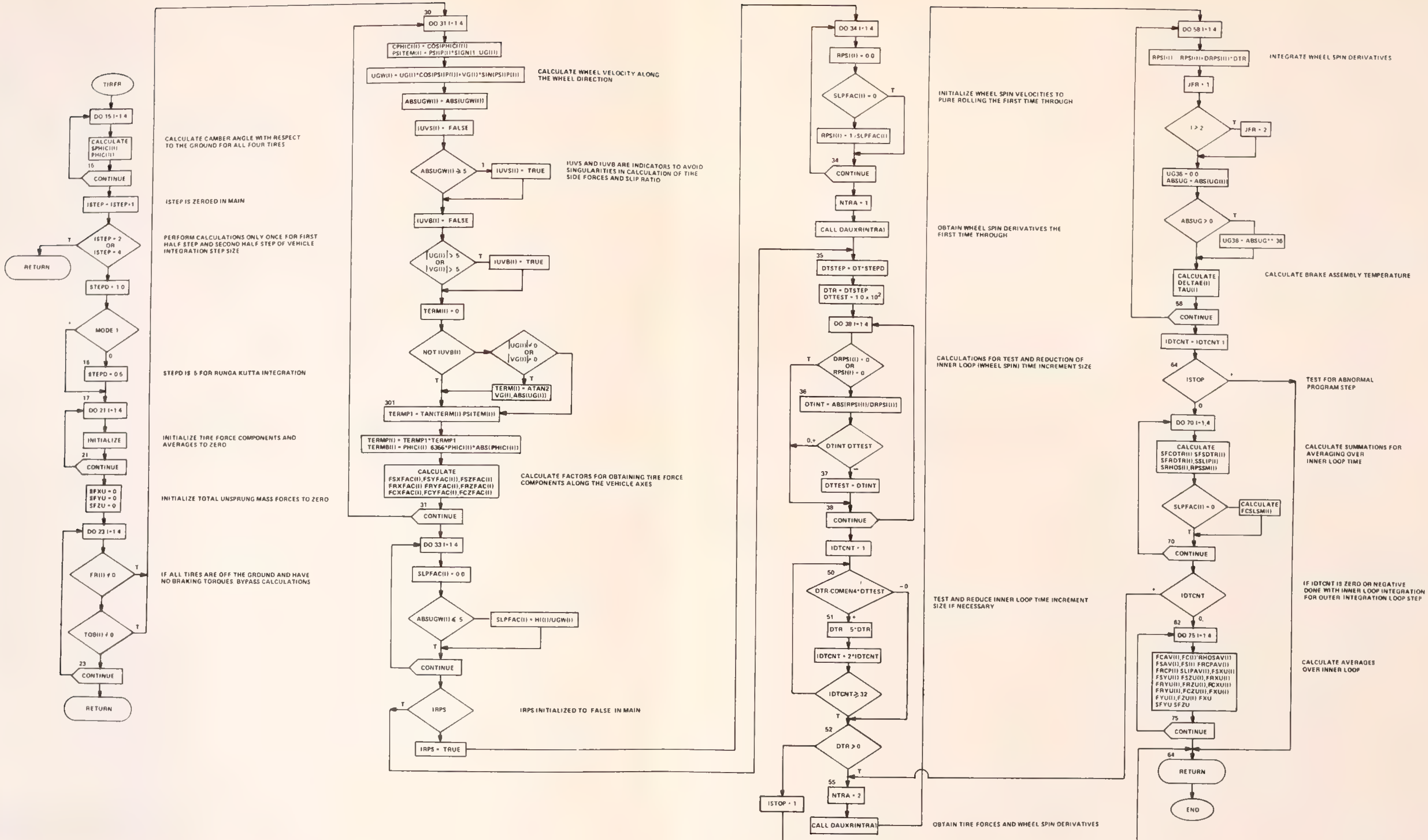
FC, FS, DTR, FXU, FYU, FZU, TAU, UGW, FCAV, FCXU, FCYU, FCZU, FRCP, FRXU, FRYU, FRZU, FSAV, FSXU, FSYU, FSZU, IRPS, IUVB, IUVS, RPSI, SFXU, SFYU, SFZU, TERM, DTINT, ISTEP, ISTOP, RPSSM, SRHOS, SSLIP, STEPD, TERMB, TERMP, ABSUGW, CPHICI, DELTAE, DISTEP, DTTEST, FCSLSM, FCXFAC, FCYFAC, FCZFAC, FRCPAV, FRXFAC, FRYFAC, FRZFAC, FSXFAC, FSYFAC, FSZFAC, IDTCNT, PSITEM, RHOSAV, SFCDTR, SFRCPR, SFSDTR, SLIPAV, SLPFAC, SPHICI

f. Size:

$B16)_{16} = 2838)_{10}$ bytes

g. Computational Procedure:


TIRFR
DO 15 I=1,4
CALCULATE SPHICI(I) PHICI(I)
15
CONTINUE
CALCULATE CAMBE
TO THE GROUND FO
ISTEP = ISTEP+1
ISTEP IS ZEROED IN
ISTEP = 2 OR ISTEP = 4
T
RETURN
PERFORM CALCULA
HALF STEP AND SEC
INTEGRATION STEP
STEPD = 1.0
MODE-1
+
0
16
STEPD = 0.5
STEPD IS .5 FOR RU
17
DO 21 I=1,4
INITIALIZE
INITIALIZE TIRE FO
AVERAGES TO ZER
21
CONTINUE
SFXU = 0. SFYU = 0. SFZU = 0.
INITIALIZE TOTAL U
DO 23 I=1,4
FR(I) ≠ 0.
T
IF ALL TIRES ARE O
NO BRAKING TORQ
TQB(I) ≠ 0.
T
23
CONTINUE
RETURN
DO 58 I=1,4
RPSI(I) = RPSI(I)+DRPSI(I)*DTR
INTEGRATE WHEEL SPIN DERIVATIVES
JFR = 1
I > 2
T
JFR = 2
UG36 = 0.0
ABSUG = ABS(UG(I))
ABSUG > 0
T
UG36 = ABSUG**.36
CALCULATE DELTAE(I) TAU(I)
CALCULATE BRAKE ASSEMBLY TEMPERATURE
58
CONTINUE
IDTCNT = IDTCNT-1
64
ISTOP
+
0
TEST FOR ABNORMAL
PROGRAM STEP.
DO 70 I=1,4
CALCULATE SFCDTR(I),SFSDTR(I) SFRDTR(I),SSLIP(I) SRHOS(I),RPSSM(I)
CALCULATE SUMMATIONS FOR
AVERAGING OVER
INNER LOOP TIME.
SLPFAC(I) = 0.
CALCULATE FCSLSM(I)
T
70
CONTINUE
IDTCNT
+
0,-
IF IDTCNT IS ZERO OR NEGATIVE,
DONE WITH INNER LOOP INTEGRATION
FOR OUTER INTEGRATION LOOP STEP.
62
DO 75 I=1,4
FCAV(I),FC(I)*RHOSAV(I) FSAV(I),FS(I),FRCPAV(I) FRCP(I),SLIPAV(I),FSXU(I) FSYU(I),FSZU(I),FRXU(I) FRYU(I),FRZU(I),FCXU(I) FRYU(I),FCZU(I),FXU(I) FYU(I),FZU(I),FXU SFYU,SFZU
CALCULATE AVERAGES
OVER INNER LOOP.
75
CONTINUE
64
RETURN
END



TIRFR
DO 15 I=1 4
CALCULATE SPHIC(I) PHIC(I)
CALCULATE CAMBER ANGLE WITH RESPECT TO THE GROUND FOR ALL FOUR TIRES
CONTINUE
ISTEP = ISTEP+1
ISTEP IS ZEROED IN MAIN
ISTEP = 2 OR ISTEP = 4
PERFORM CALCULATIONS ONLY ONCE FOR FIRST HALF STEP AND SECOND HALF STEP OF VEHICLE INTEGRATION STEP SIZE
RETURN
STEPD = 1.0
MODE 1
STEPD = 0.5
STEPD IS .5 FOR RUNGA KUTTA INTEGRATION
DO 21 I=1 4
INITIALIZE
INITIALIZE TIRE FORCE COMPONENTS AND AVERAGES TO ZERO
CONTINUE
SFXU = 0
SFYU = 0
SFZU = 0
INITIALIZE TOTAL UNSPRUNG MASS FORCES TO ZERO
DO 23 I=1 4
FR(I) ≠ 0
IF ALL TIRES ARE OFF THE GROUND AND HAVE NO BRAKING TORQUES BYPASS CALCULATIONS
TOB(I) ≠ 0
CONTINUE
RETURN
DO 31 I=1 4
CPHIC(I) = COS(PHIC(I))
PSITEM(I) = PSIIP(I)*SIGN(1 UG(I))
UGW(I) = UG(I)*COS(PSIIP(I))+VG(I)*SIN(PSIIP(I))
CALCULATE WHEEL VELOCITY ALONG THE WHEEL DIRECTION
ABSUGW(I) = ABS(UGW(I))
IUVS(I) = FALSE
ABSUGW(I) ≥ 5
IUVS(I) = TRUE
IUVS AND IUVB ARE INDICATORS TO AVOID SINGULARITIES IN CALCULATION OF TIRE SIDE FORCES AND SLIP RATIO
IUVB(I) = FALSE
|UG(I)| > 5 OR |VG(I)| > 5
IUVB(I) = TRUE
TERM(I) = 0
NOT IUVB(I)
|UG(I)| ≠ 0 OR |VG(I)| ≠ 0
TERM(I) = ATAN2 VG(I),ABS(UG(I))
TERMP1 = TAN(TERM(I) PSITEM(I))
TERMP(I) = TERMP1*TERMP1
TERMB(I) = PHIC(I) 6366*PHIC(I)*ABS(PHIC(I))
CALCULATE FSXFAC(I),FSYFAC(I),FSZFAC(I) FRXFAC(I) FRYFAC(I),FRZFAC(I) FCXFAC(I),FCYFAC(I),FCZFAC(I)
CALCULATE FACTORS FOR OBTAINING TIRE FORCE COMPONENTS ALONG THE VEHICLE AXES
CONTINUE
DO 33 I=1 4
SLPFAC(I) = 0.0
ABSUGW(I) ≤ 5
SLPFAC(I) = H(I)/UGW(I)
CONTINUE
IRPS
IRPS INITIALIZED TO FALSE IN MAIN
IRPS = TRUE
DO 34 I=1 4
RPS(I) = 0.0
SLPFAC(I) = 0
RPS(I) = 1 /SLPFAC(I)
INITIALIZE WHEEL SPIN VELOCITIES TO PURE ROLLING THE FIRST TIME THROUGH
CONTINUE
NTRA = 1
CALL DAUXR(NTRA)
OBTAIN WHEEL SPIN DERIVATIVES THE FIRST TIME THROUGH
DTSTEP = DT*STEPD
DTR = DTSTEP
DTTEST = 1.0 x 10²
DO 38 I=1 4
DRPS(I) = 0 OR RPS(I) = 0
CALCULATIONS FOR TEST AND REDUCTION OF INNER LOOP (WHEEL SPIN) TIME INCREMENT SIZE
DTINT = ABS(RPS(I)/DRPS(I))
DTINT DTTEST
DTTEST = DTINT
CONTINUE
IDTCNT = 1
DTR COMEN4*DTTEST
TEST AND REDUCE INNER LOOP TIME INCREMENT SIZE IF NECESSARY
DTR 5*DTR
IDTCNT = 2*IDTCNT
IDTCNT ≥ 32
DTR > 0
ISTOP = 1
NTRA = 2
CALL DAUXR(NTRA)
OBTAIN TIRE FORCES AND WHEEL SPIN DERIVATIVES
DO 58 I=1 4
RPS(I) = RPS(I)+DRPS(I)*DTR
INTEGRATE WHEEL SPIN DERIVATIVES
JFR = 1
I > 2
JFR = 2
UG36 = 0.0
ABSUG = ABS(UG(I))
ABSUG > 0
UG36 = ABSUG** 36
CALCULATE DELTAE(I) TAU(I)
CALCULATE BRAKE ASSEMBLY TEMPERATURE
CONTINUE
IDTCNT = IDTCNT 1
ISTOP
TEST FOR ABNORMAL PROGRAM STEP
DO 70 I=1,4
CALCULATE SFCOTR(I) SFSDTR(I) SFRDTR(I),SSLIP(I) SRHOS(I),RPSSM(I)
CALCULATE SUMMATIONS FOR AVERAGING OVER INNER LOOP TIME
SLPFAC(I) = 0
CALCULATE FCSLSM(I)
CONTINUE
IDTCNT
IF IDTCNT IS ZERO OR NEGATIVE DONE WITH INNER LOOP INTEGRATION FOR OUTER INTEGRATION LOOP STEP
DO 75 I=1 8
FCAV(I),FC(I)*RHOSAV(I) FSAV(I),FS(I) FRCPAV(I) FRCP(I) SLIPAV(I),FSXU(I) FSYU(I) FSZU(I),FRXU(I) FRYU(I),FRZU(I),FCXU(I) FRYU(I),FCZU(I),FXU(I) FYU(I),FZU(I) FXU SFYU SFZU
CALCULATE AVERAGES OVER INNER LOOP
CONTINUE
RETURN
END

ndent variables that are required in

coordinate system if necessary

:

EX, COMP4, INPT5, INSUS,

lated:

, UQ, UR, VP, VR, WP, WQ, D21,
TH, GSTH, PHFP, PHIT, PHRP,
, TIZ2, WFMF, ZFD1, ZFD2, ZRD3,
SPH, COSPS, COSTH, CPHTP, CPSTP,
D3P4, D1MD2, D1PD2, D3MD4,
HIR2, RPF2M, RPHFD, RPHRD, SECTP,
PHTP, SPSTP, TANTP, THETT, XINDL,
RD34, COSPHN, COSPSN, COSTHN,
, SINPHN, SINPSN, SINTHN, STHETP,

s

re:

ndent variables
te system indexing; if required as

43. SUBROUTINE TMCNST

a. Purpose:

1. Evaluate time dependent variables that are required in other subroutines
2. Test for and index coordinate system if necessary

b. Common Blocks Required:

INPT, INTG, COMP, EINDEX, COMP4, INPT5, INSUS, SUSCMP, NEWCRB

c. Subroutines Required:

None

d. Arguments:

None

e. Common Variables Calculated:

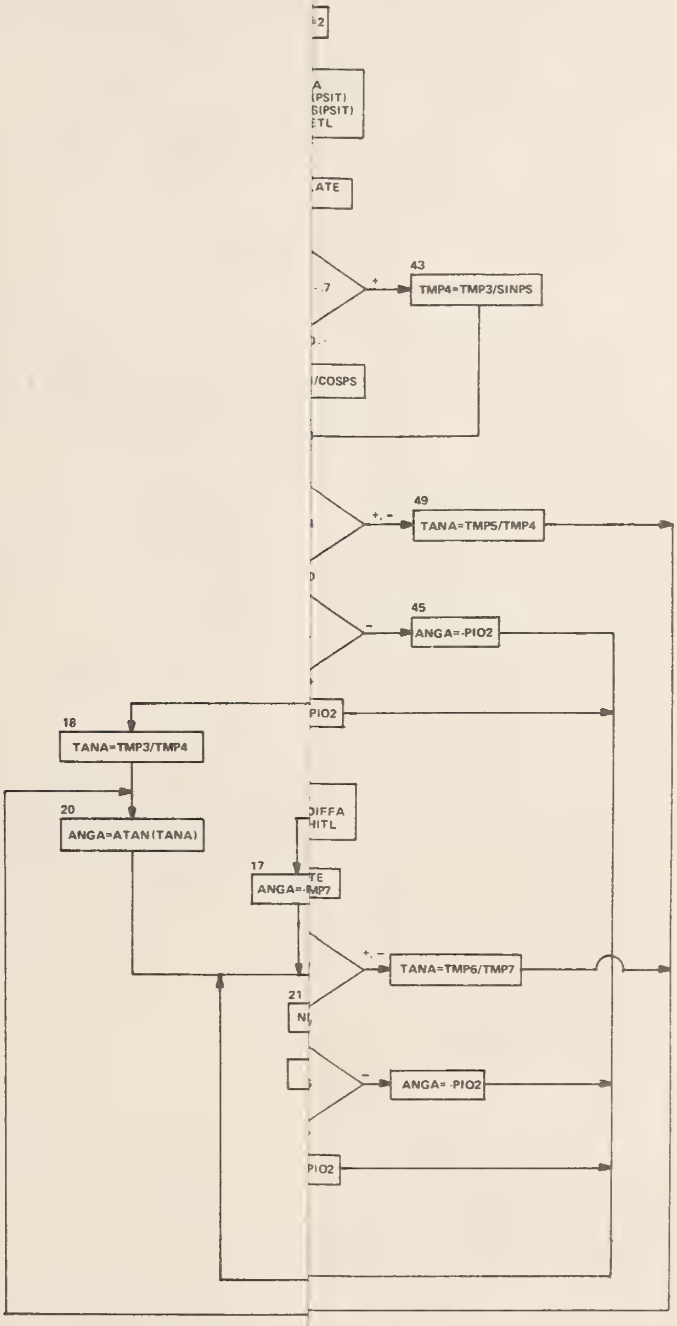
PQ, PR, P2, QR, Q2, R2, UQ, UR, VP, VR, WP, WQ, D21, D43, RPR, TPF, TPR, GCTH, GSTH, PHFP, PHIT, PHRP, PSIT, RFPF, SFXS, TG61, TIZ2, WFMF, ZFD1, ZFD2, ZRD3, ZRD4, BNMTX, CNMTX, COSPH, COSPS, COSTH, CPHTP, CPSTP, DD1M2, DD1P2, DD3M4, DD3P4, D1MD2, D1PD2, D3MD4, D3PD4, ISTOP, PHIF2, PHIR2, RPF2M, RPHFD, RPHRD, SECTP, SINPH, SINPS, SINTH, SPHTP, SPSTP, TANTP, THETT, XINDL, ZFD12, ZFD3R, ZRD3R, ZRD34, COSPHN, COSPSN, COSTHN, CTHETP, PHIFD2, PHIRD2, SINPHN, SINPSN, SINTHN, STHETP, ZFD1RF

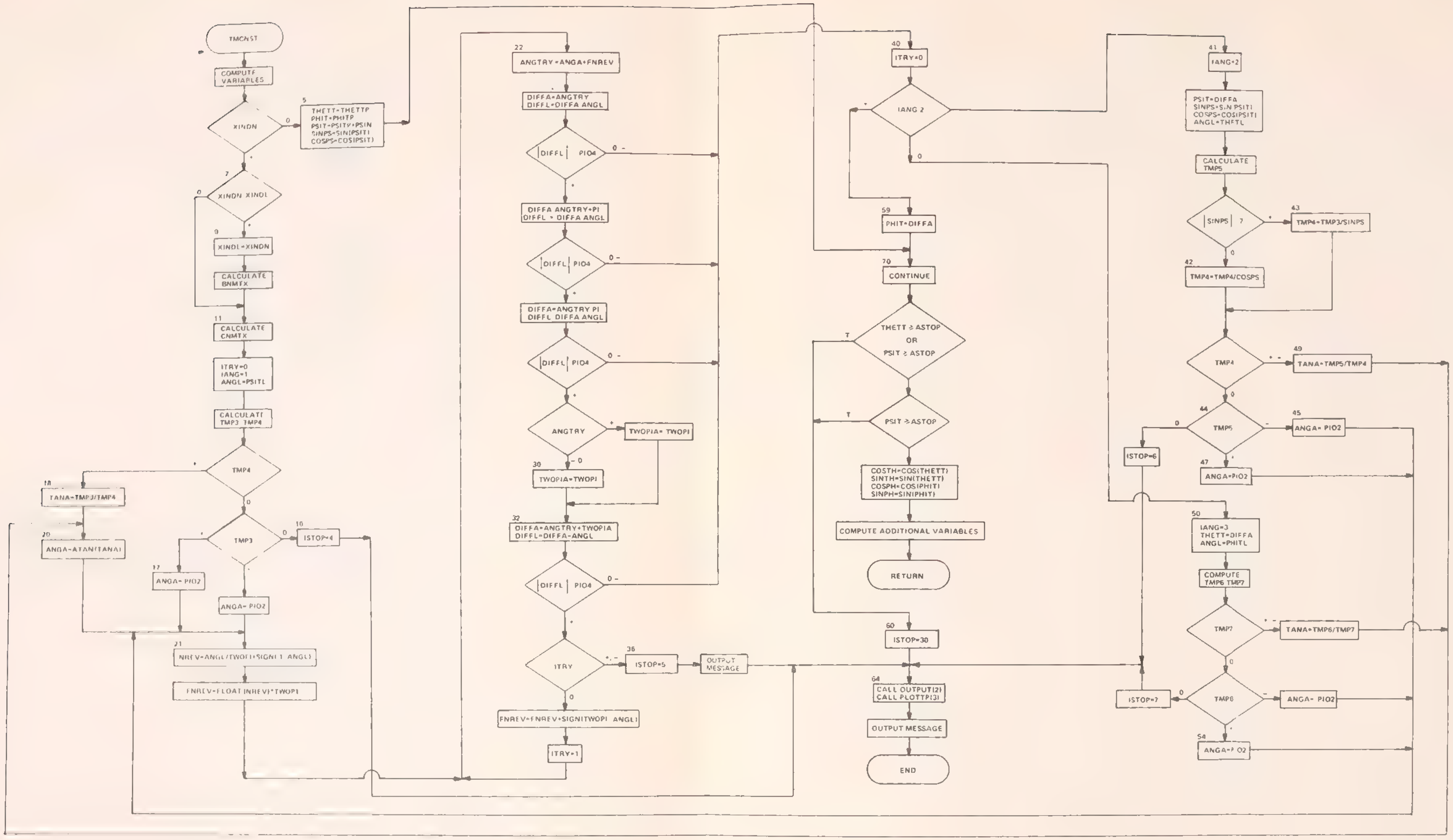
f. Size:

$D96)_{16} = 3478)_{10}$ bytes

g. Computational Procedure:

1. Compute time dependent variables
2. Test for coordinate system indexing; if required as shown below


43
TMP4=TMP3/SINPS
49
TANA=TMP5/TMP4
45
ANGA=-PIO2
18
TANA=TMP3/TMP4
20
ANGA=ATAN(TANA)
17
TANA=TMP6/TMP7
21
ANGA= -PIO2


TMCNST
COMPUTE VARIABLES
XINDN
THETT=THETTP
PHIT=PHITP
PSIT=PSITY+PSIN
SINPS=SIN(PSIT)
COSPS=COS(PSIT)
XINDN XINDL
XINDL=XINDN
CALCULATE BNMTX
CALCULATE CNMTX
ITRY=0
IANG=1
ANGL=PSITL
CALCULATE TMP3 TMP4
TMP4
TMP3
ISTOP=4
ANGA=PIO2
ANGA=ATAN(TANA)
ANGTRY=ANGA+FNREV
ITRY
ISTOP=5
OUTPUT MESSAGE
ITRY=1
ITRY=0
IANG 2
PHIT=DIFFA
CONTINUE
THETT ≥ ASTOP
OR
PSIT ≥ ASTOP
PSIT ≥ ASTOP
COSTH=COS(THETT)
SINTH=SIN(THETT)
COSPH=COS(PHIT)
SINPH=SIN(PHIT)
COMPUTE ADDITIONAL VARIABLES
RETURN
ISTOP=30
CALL OUTPUT(2)
CALL PLOTT(3)
OUTPUT MESSAGE
END
IANG=2
PSIT=DIFFA
ANGL=THETL
CALCULATE TMP5
TMP4=TMP3/SINPS
TMP4=TMP4/COSPS
TMP4
TANA=TMP5/TMP4
TMP5
ANGA=PIO2
ISTOP=6
IANG=3
THETT=DIFFA
ANGL=PHITL
COMPUTE TMP6 TMP7
TMP7
TANA=TMP6/TMP7
TMP6
ANGA=PIO2
ISTOP=7

44. SUBROUTINE TREAD

a. Purpose:

1. This subroutine reads a one-dimensional card input table

b. Common Blocks Required:

None

c. Subroutines Required:

None

d. Arguments:

NCARD - Input card number
NCRDS - Number of cards to be read
NT - Number of elements to be read into the table
NDIM - Maximum table dimension
ARRAY - Table array
NERR - Error indicator

e. Common Variables Calculated:

None

f. Size:

$258)_{16} = 600)_{10}$ bytes

g. Computational Procedure:

1. Read table input cards checking to insure that the table sequence number increases with each card.
2. Load the variables into the table array.

45. SUBROUTINE T2READ

a. Purpose:

1. This subroutine reads a two-dimensional input table

b. Common Blocks Required:

None

c. Subroutines Required:

None

d. Arguments:

NCARD - Input card number
ND1 - Row dimension of the input table
NI - Number of rows to be read
NJ - Number of columns to be read
ARRAY - Table array
NERR - Error indicator

e. Common Variables Calculated:

None

f. Size:

$2C4)_{16} = 708)_{10}$ bytes

g. Computational Procedure:

The input table is read rowwise with the second subscript varying most rapidly.

46. SUBROUTINE UMOMNT(IS)

a. Purpose:

1. This subroutine calculates the moments acting on the sprung and unsprung masses

b. Common Blocks Required:

INPT, DIMV, COMP, INSUS, SUSCMP

c. Subroutines Required:

None

d. Arguments:

IS - suspension option indicator

e. Common Variables Calculated:

SNPF, SNPR, SNPU, SNTU, SNPSU, TERM1, TERM2, TERM3

f. Size:

$822)_{16} = 2082)_{10}$ bytes

g. Computational Procedure:

1. For IS=0 (independent front, solid axle rear suspension) calculate the sprung mass roll, pitch and yaw moments (SNPU, SNTU, SNPSU) and the rear axle roll moment (SNPR).
2. For IS=1 (independent front and rear suspension) calculate the sprung mass roll, pitch and yaw moments (SNPU, SNTU, SNPSU).
3. For IS=2 (solid front and rear axles) calculate the sprung mass roll, pitch and yaw moments (SNPU, SNTU, SNPSU) and the front and rear axle roll moments (SNPF, SNPR).

47. SUBROUTINE VGORNT

a. Purpose:

1. Determine the orientation of the vehicle wheels with respect to the ground.

b. Common Blocks Required:

INPT, INPT1, INTG, DIMV, COMP, COMPN, ADTNL, TIRIN, INSUS, SUSCMP, NEWCRB, RUFNES

c. Subroutines Required:

INTRP5, GCP, CRBIMP, RUFFRC

d. Arguments:

None

e. Variables Calculated:

AS, AX, AY, BS, BX, BY, CS, CX, CY, D1, D2, D3, P1, P3, P4, P5, P6, P7, UG, VG, V1, V2, V3, V4, W1, W2, W3, W4, CAC, CAH, CAS, CBC, CBH, CBS, CGC, CGH, CGS, CTG, STG, CAGZ, CAYW, CAZW, CBGZ, CBYW, CBZW, CGGZ, CGYW, CGZW, CPYG, CTXG, HCAH, HCBH, HCGH, LCB1, LCB2, PHGI, SPYG, STXG, THGI, TMP3, TMP4, ZPGI, DISTX, DISTY, PSIIP, XMUGI

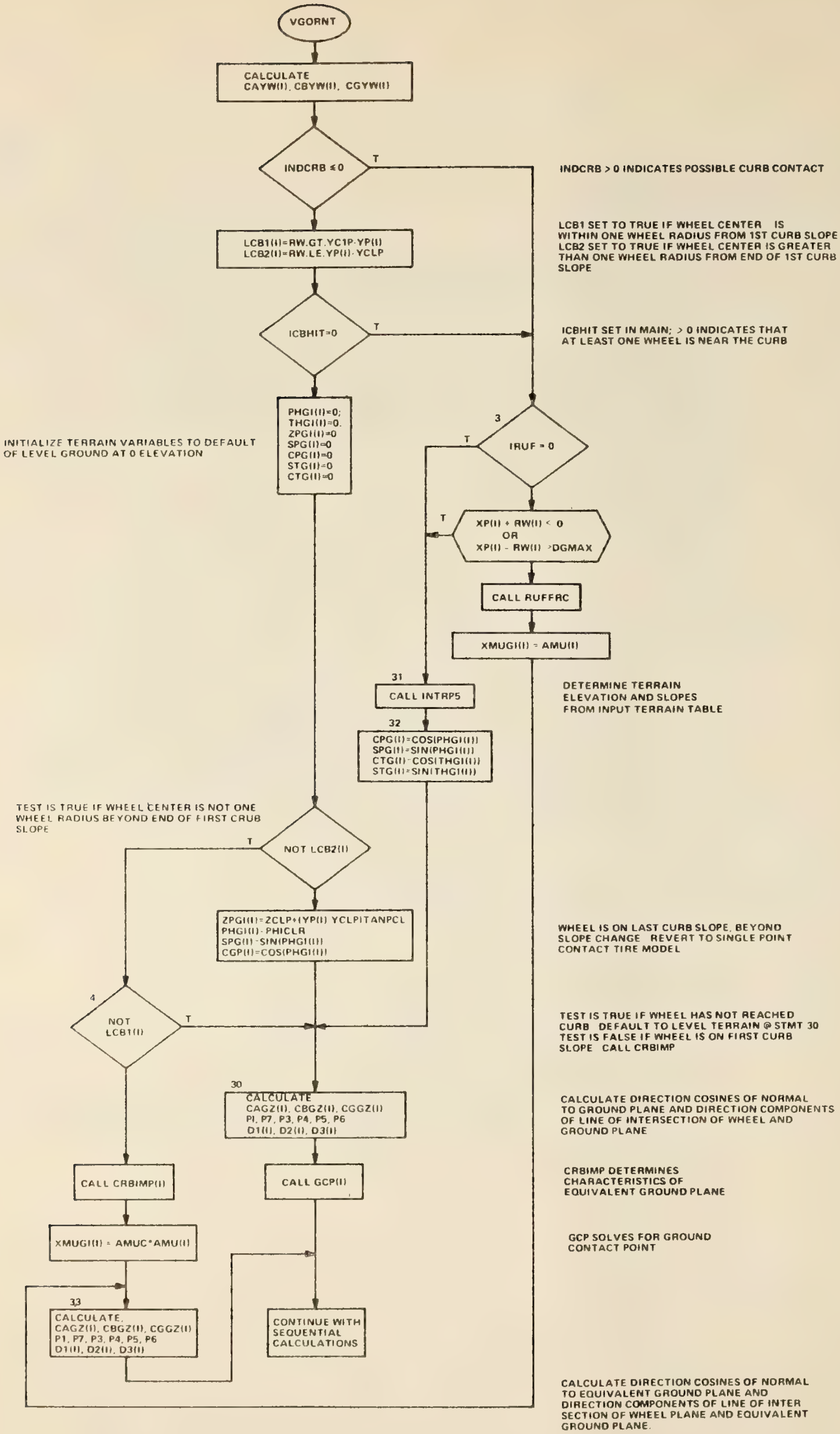
f. Size:

$1002)_{16} = 4098)_{10}$ bytes

g. Computational Procedure:

For wheels I = 1 to 4

1. Calculate the direction cosines of the normal to the wheel plane.
2. Determine the direction cosines of a normal to the ground plane and direction components of the intersection of the wheel plane and ground plane as follows:


VGORNT
CALCULATE CAYW(I), CBYW(I), CGYW(I)
INDCRB ≤ 0
T
INDCRB > 0 INDICATES POSSIBLE CURB CONTACT
LCB1(I)=RW.GT.YC1P-YP(I)
LCB2(I)=RW.LE.YP(I)-YCLP
LCB1 SET TO TRUE IF WHEEL CENTER IS WITHIN ONE WHEEL RADIUS FROM 1ST CURB SLOPE LCB2 SET TO TRUE IF WHEEL CENTER IS GREATER THAN ONE WHEEL RADIUS FROM END OF 1ST CURB SLOPE
ICBHIT=0
T
ICBHIT SET IN MAIN; > 0 INDICATES THAT AT LEAST ONE WHEEL IS NEAR THE CURB
PHGI(I)=0; THGI(I)=0. ZPGI(I)=0 SPG(I)=0 CPG(I)=0 STG(I)=0 CTG(I)=0
INITIALIZE TERRAIN VARIABLES TO DEFAULT OF LEVEL GROUND AT 0 ELEVATION
3
IRUF = 0
T
XP(I) + RW(I) < 0 OR XP(I) - RW(I) >DGMAX
T
CALL RUFFRC
XMUGI(I) = AMU(I)
31
CALL INTRP5
DETERMINE TERRAIN ELEVATION AND SLOPES FROM INPUT TERRAIN TABLE
32
CPG(I)=COS(PHGI(I)) SPG(I)=SIN(PHGI(I)) CTG(I)=COS(THGI(I)) STG(I)=SIN(THGI(I))
TEST IS TRUE IF WHEEL CENTER IS NOT ONE WHEEL RADIUS BEYOND END OF FIRST CRUB SLOPE
NOT LCB2(I)
T
ZPGI(I)=ZCLP+(YP(I)-YCLP)TANPCL PHGI(I)=PHICLR SPG(I)=SIN(PHGI(I)) CGP(I)=COS(PHGI(I))
WHEEL IS ON LAST CURB SLOPE, BEYOND SLOPE CHANGE REVERT TO SINGLE POINT CONTACT TIRE MODEL
4
NOT LCB1(I)
T
TEST IS TRUE IF WHEEL HAS NOT REACHED CURB DEFAULT TO LEVEL TERRAIN @ STMT 30 TEST IS FALSE IF WHEEL IS ON FIRST CURB SLOPE CALL CRBIMP
30
CALCULATE CAGZ(I), CBGZ(I), CGGZ(I) PI, P7, P3, P4, P5, P6 D1(I), D2(I), D3(I)
CALCULATE DIRECTION COSINES OF NORMAL TO GROUND PLANE AND DIRECTION COMPONENTS OF LINE OF INTERSECTION OF WHEEL AND GROUND PLANE
CALL CRBIMP(I)
CALL GCP(I)
CRBIMP DETERMINES CHARACTERISTICS OF EQUIVALENT GROUND PLANE
XMUGI(I) = AMUC*AMU(I)
GCP SOLVES FOR GROUND CONTACT POINT
33
CALCULATE, CAGZ(I), CBGZ(I), CGGZ(I) P1, P7, P3, P4, P5, P6 D1(I), D2(I), D3(I)
CONTINUE WITH SEQUENTIAL CALCULATIONS
CALCULATE DIRECTION COSINES OF NORMAL TO EQUIVALENT GROUND PLANE AND DIRECTION COMPONENTS OF LINE OF INTER SECTION OF WHEEL PLANE AND EQUIVALENT GROUND PLANE.

3. Calculate the direction cosines of the line of action of the radial tire force with respect to the vehicle axes, CAH(I), CBH(I), CGH(I).
4. Calculate the lateral and vertical velocities of the tire at the ground contact point with components resolved in the vehicle axes, (V1,W1); (V2,W2); (V3,W3); (V4,W4).
5. Calculate the direction components of the vehicle x axis projected into the ground plane, AX(I), BX(I), CX(I).
6. Calculate the sine and cosine of the angle between the vehicle x axis and its projection into the ground plane STXG(I), CTXG(I).
7. Calculate the longitudinal velocity of the tire contact point parallel to the ground plane UG(I).
8. Calculate the direction components of the vehicle y axis projected into the ground plane, AY(I), BY(I), CY(I).
9. Calculate the sine and cosine of the angle between the vehicle y axis and its projection into the ground plane SPYG(I), CPYG(I).
10. Calculate the lateral velocity of the tire contact point parallel to the ground plane, VG(I).
11. Calculate the direction cosines of the steering axis of the wheel.
12. Calculate the steer angle in the ground plane, PSIIP(I).
13. Calculate the direction cosines of the line of action of the circumferential tire force (CAC(I), CBC(I), CGC(I)) and of the tire side force (CAS(I), CBS(I), CGS(I)).

48. SUBROUTINE VPOS

a. Purpose:

1. Compute positions, orientations and velocities of the vehicle wheels
2. Calculate directions of the x and y axis in space

b. Common Blocks Required:

INPT, INPT1, INTG, DIMV, COMP, COMPN, ADTNL, INSUS, SUSCMP

c. Subroutines Required:

INTRPL, DRIVER

d. Arguments:

None

e. Variables Calculated:

U1, U2, U3, U4, CAX, CAY, CBX, CBY, CGX, CGY, X1P, X2P, X3P, X4P, Y1P, Y2P, Y3P, Y4P, Z1P, Z2P, Z3P, Z4P, AMTX, PHI1, PHI2, PHI3, PHI4, PSI1, PSI2, PSI3, PSI4, DTDD1, DTDD2, DTDD3, DTDD4, DTHF1, DTHF2, DTHF3, DTHF4, PHI1D, PHI2D, PHI3D, PHI4D, PSIFI, SFYUF, SFYUR, PHIFID, SLOPE1, SLOPE2, SLOPE3, SLOPE4

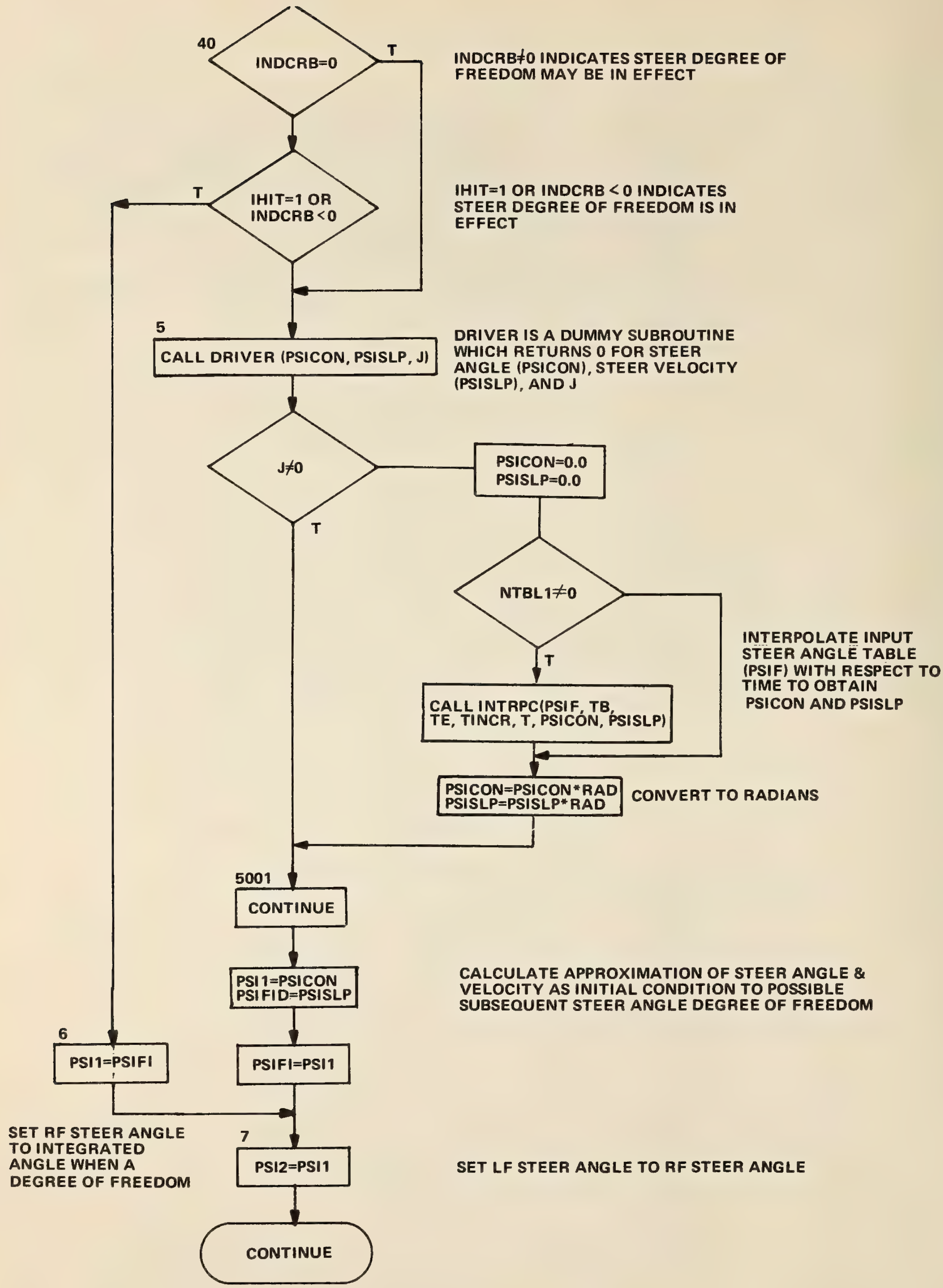
f. Size:

$AA4)_{16} = 2724)_{10}$ bytes

g. Computational Procedure:

1. Calculate longitudinal velocities of wheel centers along the vehicle axes, U1, U2, U3, U4. Note that for independent suspension options, INTRPC is called to obtain the track change and rate of track change as a function of suspension position.
2. Zero forces acting on the unsprung masses SFYU = SFXU = SFYUF = SFYUR = SFZU = 0.
3. Calculate AMTX, the transformation matrix from vehicle to space coordinate systems.
4. Calculate direction cosines of the vehicle x and y axis in space (CAX, CBX, CGX and CAY, CBY, CGY).
5. Calculate positions of the wheel centers in space (X1P, Y1P, Z1P); (X2P, Y2P, Z2P); (X3P, Y3P, Z3P); (X4P, Y4P, Z4P).

6. Call INTRPC (entry point in INTRPL) to obtain wheel camber angles and rates of change of camber angles with deflection by interpolation of the input camber tables with respect to suspension deflection for independent suspension options. Note that since the input table of camber is in units of degrees, a conversion in radians is also made.
7. Determine the front wheel steer angle with the following logic.



40
INDCRB=0
T
INDCRB≠0 INDICATES STEER DEGREE OF FREEDOM MAY BE IN EFFECT
T
IHIT=1 OR INDCRB<0
IHIT=1 OR INDCRB < 0 INDICATES STEER DEGREE OF FREEDOM IS IN EFFECT
5
CALL DRIVER (PSICON, PSISLP, J)
DRIVER IS A DUMMY SUBROUTINE WHICH RETURNS 0 FOR STEER ANGLE (PSICON), STEER VELOCITY (PSISLP), AND J
J≠0
T
PSICON=0.0
PSISLP=0.0
NTBL1≠0
T
INTERPOLATE INPUT STEER ANGLE TABLE (PSIF) WITH RESPECT TO TIME TO OBTAIN PSICON AND PSISLP
CALL INTRPC(PSIF, TB, TE, TINCR, T, PSICON, PSISLP)
PSICON=PSICON*RAD
PSISLP=PSISLP*RAD
CONVERT TO RADIANS
5001
CONTINUE
PSI1=PSICON
PSIFID=PSISLP
CALCULATE APPROXIMATION OF STEER ANGLE & VELOCITY AS INITIAL CONDITION TO POSSIBLE SUBSEQUENT STEER ANGLE DEGREE OF FREEDOM
6
PSI1=PSIFI
PSIFI=PSI1
SET RF STEER ANGLE TO INTEGRATED ANGLE WHEN A DEGREE OF FREEDOM
7
PSI2=PSI1
SET LF STEER ANGLE TO RF STEER ANGLE
CONTINUE

49. SUBROUTINE WHEEL

a. Purpose:

1. To calculate equivalent tire radial mode spring rates

b. Common Blocks Required:

None

c. Subroutines Required:

None

d. Arguments:

AKT - Point contact model tire spring rate
SIGT - Point contact model tire deflection at which spring rate increases
XLAMT - Spring rate increase
RWHJB - Beginning deflection for radial spring table
RWHJE - Ending deflection for radial spring table
DRWHJ - Deflection increment for radial spring table
NFJP - Number of radial spring table entries
RW - Undeflected tire radius
FJP - Radial spring force table
NO - Maximum number of entries in radial spring force table

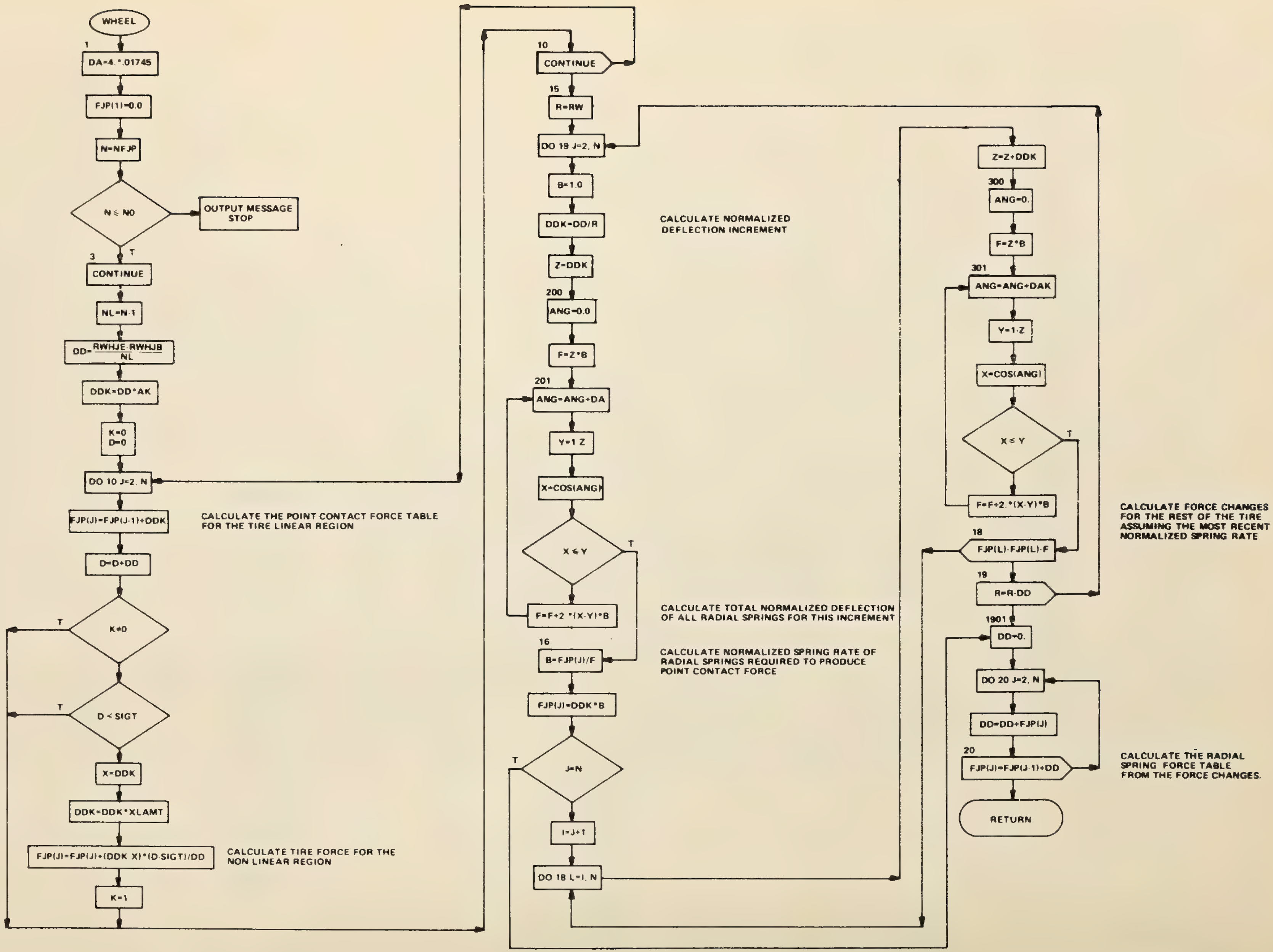
e. Common Variables Calculated:

None

f. Size:

$4FA)_{16} = 1274)_{10}$ bytes

g. Computational Procedure:


WHEEL
1
DA=4.*.01745
FJP(1)=0.0
N=NFJP
N ≤ N0
OUTPUT MESSAGE STOP
T
3
CONTINUE
NL=N-1
DD=RWHJE-RWHJB / NL
DDK=DD*AK
K=0 D=0
DO 10 J=2, N
FJP(J)=FJP(J-1)+DDK
CALCULATE THE POINT CONTACT FORCE TABLE FOR THE TIRE LINEAR REGION
D=D+DD
K≠0
T
D < SIGT
T
X=DDK
DDK=DDK*XLAMT
FJP(J)=FJP(J)+(DDK X)*(D-SIGT)/DD
CALCULATE TIRE FORCE FOR THE NON LINEAR REGION
K=1
10
CONTINUE
15
R=RW
DO 19 J=2, N
B=1.0
DDK=DD/R
CALCULATE NORMALIZED DEFLECTION INCREMENT
Z=DDK
200
ANG=0.0
F=Z*B
201
ANG=ANG+DA
Y=1 Z
X=COS(ANG)
X ≤ Y
T
F=F+2.*(X-Y)*B
CALCULATE TOTAL NORMALIZED DEFLECTION OF ALL RADIAL SPRINGS FOR THIS INCREMENT
16
B=FJP(J)/F
CALCULATE NORMALIZED SPRING RATE OF RADIAL SPRINGS REQUIRED TO PRODUCE POINT CONTACT FORCE
FJP(J)=DDK*B
J=N
T
I=J+1
DO 18 L=I, N
Z=Z+DDK
300
ANG=0.
F=Z*B
301
ANG=ANG+DAK
Y=1-Z
X=COS(ANG)
X ≤ Y
T
F=F+2.*(X-Y)*B
CALCULATE FORCE CHANGES FOR THE REST OF THE TIRE ASSUMING THE MOST RECENT NORMALIZED SPRING RATE
18
FJP(L)-FJP(L)-F
19
R=R-DD
1901
DD=0.
DO 20 J=2, N
DD=DD+FJP(J)
20
FJP(J)=FJP(J-1)+DD
CALCULATE THE RADIAL SPRING FORCE TABLE FROM THE FORCE CHANGES.
RETURN

3.2.2 HVOSM-VD2 Program Stops and Messages

Program stops include both normal and abnormal stops. Normal stops occur when the cumulative simulated time (T) exceeds the desired final time (T1) as input in field 2 of card 101, or when the magnitudes of both the linear and angular velocities of the vehicle sprung mass are less than or equal to the input minimums (UVWMIN and PQRMIN, card 101, fields 6 and 7). When these stops occur, no message is output and the program attempts to read another set of data cards.

Abnormal stops occur when a condition is encountered that the program is not designed to handle or an unresolvable error has occurred. The first type of abnormal stop occurs when rollover of the vehicle is immenent. That is, when the vehicle has rolled to an angle of 90° in either direction.

Abnormal stops are also indicated by a non-zero value for the variable ISTOP. The following codes identify the type and location of the error.

ISTOP = 1	Subroutine TIRFR. An error has occurred in determination of the wheel spin integration interval.
ISTOP = 4	Subroutine TMCNST. The denomenator of the expression used to calculate the value of PSIT after indexing of coordinate system is zero.
ISTOP = 5	Subroutine TMCNST. The logic associated with coordinate system indexing has been usable to determine the correct quadrant for PSIT, PHET or THETT.

ISTOP = 6 Subroutine TMCNST. The numerator in the expression for calculation of THETT after coordinate system indexing is zero.

ISTOP = 7 Subroutine TMCNST. The numerator in the expression for calculation of PHIT after coordinate system indexing is zero.

ISTOP = 30 Subroutine TMCNST. One of the recalculated Euler angles (PSIT, THETT, PHIT) has been computed as being very large (>3000 radians) after coordinate system indexing. A probable error has occurred.

When an ISTOP $\neq$ 0 condition is encountered, the program prints all output up to the time of the error, prints the value of ISTOP, terminates execution of the current run and attempts to read another set of data cards.

In subroutine CTQD, a message will be printed if the tabular time range of the TTS, TTR and TPC tables is exceeded. The program continues execution with the last entries in the tables.

Similarly, in subroutine CTQB, a message is printed if the temperature range of the FLF table is exceeded. The program again continues execution using the last value in the table.

In subroutine INPUT, the following messages are printed if difficulties are encountered in reading the card data deck.

UNEXPECTED END OF FILE ENCOUNTERED IN STMT NO. 1 OF SUBROUTINE INPUT. LAST CARD READ WAS XXXX.

A CARD NUMBERED LESS THAN OR EQUAL TO ZERO WAS ENCOUNTERED IN SUBROUTINE INPUT. CARD IMAGE PRINTED ABOVE.

THE NUMBER OF CARDS READ IS ZERO.

A BLOCK NUMBER OF LESS THAN OR EQUAL TO ZERO HAS BEEN OBTAINED.

A BLOCK NUMBER LARGER THAN THE ALLOWED NUMBER HAS BEEN OBTAINED.

AN ERROR HAS OCCURRED IN STORING INPUT VALUES IN ONE OF THE BLKXX SUBROUTINES. THE CALLING ARGUMENTS FROM INPUT ARE: NBLK = XXXX NBCRD = XXXX NSEQ = XXXX NCARD = XXXX.

In subroutine RUFRED, two messages may be printed if difficulties are encountered in reading road roughness data from FORTRAN device 4. They are:

END OF FILE ENCOUNTERED IN READ OF ROUGHNESS DATA BEFORE NEND POINTS WERE READ.

NUMBER OF LAST ROUGHNESS DATA POINT IS GREATER THAN THE ALLOWED 2200. PROGRAM TERMINATED.

3.2.3 HVOSM-VD2 Program Listing

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C         HIGHWAY VEHICLE OBJECT SIMULATION MODEL
C           MAIN ROUTINE
C        HVOSM-VD2 VERSION
C           REVISED OCTOBER 1975  CALSPAN CORPORATION
      COMMON/HEAD/ VHED(20),CHED(20),GHED(20),SHED(20),THED(20),
     1             NPAGE(20)
      COMMON/INPT/PHIO,THETAO,PSIO,PO,QO,RO,XCOP,YCOP,ZCOP,UO,VO,WO,
     1            A,B,DEL1O,DEL2O,DEL3O,PHIRO,DEL1OD,DEL2OD,DEL3OD,
     2            PHIROD,TF,TR,ZF,ZR,RHO,AKRS,XMUR,
     3            XMS,XMUF,XIX,XIY,XIZ,XIXZ,CF,AKF,XLAMF,OMEGF,CFP,EPSF,
     4            RF,CR,AKR,XLAMR,OMEGR,CRP,EPSR,RR,TS,THMAX,DTCOMP,TO,
     5            T1,DTCMP1,DTPRNT,MODE,EBAR,EM,AAA,HMAX,HMIN,BET,G,
     6            HED(36),DADE(3),XIR,X1,Y1,Z1,X2,Y2,Z2,PHIC(50),DELB,
     7            DELE,DDEL,NDEL,PSIF(50),TQF(50),TQR(50),TB,TE,TINCR,
     8            NZTAB,NZ5,XBDRY(4,5),PSBDRY(4,5),YBDRY(2,5),NBX(5),
     9            NBY(5),NTBL1,NTBL2,NTBL3,ZGP(21,21,5)
      COMMON/INPT/XB(5),XE(5),XINCR(5),NX(5),YB(5),YE(5),YINCR(5),NY(5),
     1          XXZGP5(21),YYZGP5(21),AMUG(5),PSBDRO(4,5),UVWMIN,PQRMIN
      COMMON/INPT1/YC1P,YC2P,ZC2P,DELTC,PHIC1,PHIC2,AMUC,XIPS,
     1             CPSP,OMGPS,AKPS,EPSPS,XPS,RWHJB,RWHJE,DRWHJ,INDCRB,
     2             PSIFIO,PSIFDO
      DIMENSION YCIP(2)
      EQUIVALENCE (YCIP(1),YC1P)
      COMMON /INTG/NEQ,T,DT,VAR(50),DER(50)
      EQUIVALENCE (U,VAR(1)),(V,VAR(2)),(W,VAR(3)),(P,VAR(4)),(Q,VAR(5))
     1           ,(R,VAR(6)),(DEL1,VAR(7)),(DEL1D,VAR(8)),(DEL2,VAR(9)),
     2            (DEL2D,VAR(10)),(DEL3,VAR(11)),(DEL3D,VAR(12)),
     3            (PHIR,VAR(13)),(PHIRD,VAR(14)),(THETTP,VAR(15)),
     4            (PHITP,VAR(16)),(PSITP,VAR(17)),(XCP,VAR(18)),
     5            (YCP,VAR(19)),(ZCP,VAR(20)),(PSIFI,VAR(21)),
     6            (PSIFID,VAR(22))
      EQUIVALENCE (DU,DER(1)),(DV,DER(2)),(DW,DER(3)),(DP,DER(4)),
     1            (DQ,DER(5)),(DR,DER(6)),(DDEL1,DER(7)),(DDEL1D,DER(8))
     2           ,(DDEL2,DER(9)),(DDEL2D,DER(10)),(DDEL3,DER(11)),
     3            (DDEL3D,DER(12)),(DPHIR,DER(13)),(DPHIRD,DER(14)),
     4            (DTHTTP,DER(15)),(DPHITP,DER(16)),(DPSITP,DER(17)),
     5            (DXCP,DER(18)),(DYCP,DER(19)),(DZCP,DER(20)),
     6            (DPSIFI,DER(21)),(DDPSFI,DER(22))
      EQUIVALENCE (VAR(9),PHIF),(VAR(10),PHIFD),(DER(9),DPHIF),
     1            (DER(10),DPHIFD)
      EQUIVALENCE (VAR(13),DEL4),(VAR(14),DEL4D),(DER(13),DDEL4),
     1            (DER(14),DDEL4D)
      COMMON /DIMV/X1P,X2P,X3P,X4P,Y1P,Y2P,Y3P,Y4P,Z1P,Z2P,Z3P,Z4P,PHI1,
     1             PHI2,PHI3,PHI4,PSI1,PSI2,PSI3,PSI4,CAYW(4),CBYW(4),
     2             CGYW(4),ZPGI(4),THGI(4),PHGI(4),CPG(4),SPG(4),CTG(4),
     3             STG(4),CAGZ(4),CBGZ(4),CGGZ(4),D1(4),D2(4),D3(4),
     4             XLM1(4),XLM2(4),XLM3(4),AMTX(3,3),CMTX(3,4),XGPP(4),
     5             YGPP(4),ZGPP(4),DMATX(10,11),DELTA(4),CAR(4),CBR(4),
     6             CGR(4),FR(4),HI(4),FC(4),TI(4),AX(4),BX(4),CX(4),
```

```
     7          CTXG(4),UG(4),STXG(4),AY(4),BY(4),CY(4),CPYG(4),
     8          SPYG(4),VG(4),PSIIP(4),PHICI(4),CAC(4),CBC(4),CGC(4),
     9          FCXU(4),FCYU(4),FCZU(4),FS(4),CAXW(4),CBXW(4),CGXW(4)
      COMMON /DIMV/AS(4),BS(4),CS(4),CAS(4),CBS(4),CGS(4),BETP(4),
     1          BETBR(4),FSXU(4),FSYU(4),FSZU(4),FRXU(4),FRYU(4),
     2          FRZU(4),FXU(4),FYU(4),FZU(4),SI(4),F1FI(2),F1RI(2),
     3          F2FI(2),F2RI(2),CAH(4),CBH(4),CGH(4)
      DIMENSION XP(4),YP(4),ZP(4),PHII(4),PSII(4)
      EQUIVALENCE (XP(1),X1P),(YP(1),Y1P),(ZP(1),Z1P),(PHII(1),PHI1),
     1          (PSII(1),PSI1)
      COMMON /COMP/SUMM,THETN,PHIN,PSIN,PI,RAD,GAM1,GAM2,GAM3,GAM4,GAM5,
     1          GAM6,GAM7,GAM8,GAM9,THETT,PHIT,PSIT,ZRO,TRO2,
     2          TFO2,TIZ,RHO2,RHOMUR,AMUF,BMUR,ZPR,TM4,RHMR2,AO2APB,
     3          BO2APB,RFTF,TSO2,RRTS,BROMUR,XMUFO2,AXMFO2,XMTFO4,
     4          XIZR,RTR,RHMR2I,XIXP,XIZP,XIXZP,XIYZP,D1PD2,D1MD2,
     5          ZRD3,ZRD3R,ZFD3R,ZFD12,TIZ2,TG61,DD1P2,DD1M2,RPR,PHRP
     6          ,TANTP,SPHTP,CPHTP,SECTP,SFXS,SFYS,SFZS,SNPS,SNTS,
     7          SNPSS,TPR,CAY,CBY,CGY,CAX,CBX,CGX,SFYU,SFXU,SFYUF,
     8          SFYUR,SFZU,COSTH,SINTH,COSPS,SINPS,COSPH,SINPH,ANG1,
     9          ANG2,CPHI,SPHI,CPSI,SPSI,P1,P7,P3,P4,P5,P6,TX,TY,TZ
      COMMON /COMP/TRH,DISTX,DISTY,DISTD,DISTS,D21,ZETA4,ZETA4D,ZETA3,
     1          ZETA3D,SFZ1,SNPU,SNTU,HCGH1,HCGH2,HCGH3,HCGH4,TERM1,
     2          TERM2,SNPSU,SNPR,HCBH1,HCBH2,HCBH3,HCBH4,HCAH1,HCAH2,
     3          HCAH3,HCAH4,UQ,WP,UR,QR,VP,PR,P2,Q2,R2,VR,WQ,PQ,PHIR2
     4          ,PHIRD2,RPHRD,GCTH,GSTH,GCTSP,GCTCP,XXX,YYY,IX,IY,XX1,
     5          XX2,YY1,YY2,THG1,THG2,PHG1,PHG2,ZZ1,ZZ2,LLL
      DIMENSION HCAH(4),HCBH(4),HCGH(4)
      EQUIVALENCE (HCAH(1),HCAH1),(HCBH(1),HCBH1),(HCGH(1),HCGH1)
      COMMON /COMPN/ FRSP(4),FRCP(4),ICBHIT,JCBHIT,
     1          DPSINT,TANPC1,TANPC2,PHIC1R,PHIC2R,AMUCMP,PHI1D,
     2          PHI2D,LCB1(4),LCB2(4),IHIT,AJMTX(3,3),BMTX(3,3),
     3          SFRX(4),SFRY(4),SFRZ(4),T1PSI,T2PSI,XMUGI(4)
      LOGICAL LCB1,LCB2
C      COMMON/EINDEX/ FOR EULER ANGLE INDEXING,MAIN,CNSTNT,DAUX,TMCNST
      COMMON/EINDEX/ TWOPI,PIO2,PIO4,XINDN,XINDL,THETTL,PHITL,PSITL,
     1          COSTHN,SINTHN,COSPSN,SINPSN,COSPHN,SINPHN,CTHETP,
     2          STHETP,CPSTP,SPSTP,BNMTX(3,3), CNMTX(3,3),ENDEIN
      COMMON/ADTNL/ U1,U2,U3,U4,V1,V2,V3,V4,W1,W2,W3,W4,
     1          XIYP,SPHIC,CPHIC,APTCH1,APTCH2,APTCH3,APTCH4,
     2          SLOPE1,SLOPE2,XTRA(300)
      DIMENSION UI(4),VI(4),WI(4)
      EQUIVALENCE (UI(1),U1),(VI(1),V1),(WI(1),W1)
      DIMENSION APITCH(4)
      EQUIVALENCE (APITCH(1),APTCH1)
      COMMON/INPT3/ AKFC,AKFCP,OMEGFC,AKFE,AKFEP,OMEGFE,AKRC,AKRCP,
     1          OMEGRC,AKRE,AKREP,OMEGRE,END3
      COMMON/APTABL/ APFR(21,2),IAPFR(2),DAPFB,DAPFE,DDAPF,NAPF,
     1          DAPRB,DAPRE,DDAPR,NAPR
      DIMENSION APF(21),APR(21)
      EQUIVALENCE (APFR(1,1),APF(1)),(APFR(1,2),APR(1))
      COMMON /TIRIN/ AKT(4),SIGT(4),XLAMT(4),AO(4),A1(4),A2(4),A3(4),
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     1                A4(4),OMEGT(4),AMU(4),RW(4),FJP(35,4),A234(4),
     2                A12(4),OMT2A2(4),OMT2M1(4),A23(4),ITIR(4)
      COMMON /INPT4/ FIDJ(2),FIWJ(2),ARBR(2),NXUGMU,NXFRCP,XXUGMU(6),
     A                XXFRCP(6),XMUMAT(6,6,4),XMXPMT(6,6,4),
     B                XMXSMT(6,6,4),SLIPMT(6,6,4),CT(4),XMUM(4),
     C                XMUXP(4),XMUXS(4),RRMC(4),RRM(4),COMEN4
      EQUIVALENCE (FIDJ(1),FIDJF),(FIDJ(2),FIDJR),(FIWJ(1),FIWJF)
      EQUIVALENCE (FIWJ(2),FIWJR),(ARBR(1),ARBRF),(ARBR(2),ARBRR)
      COMMON /COMP4/FIDAR(2),FIDIW(2),FIDWR2(2),SPHICI(4),CPHICI(4),
     1              TIHI(4),ARBRI(4), PSITEM(4),SLPFAC(4),DTSTEP,DTTEST,
     2        DTINT,TWOPIR,FRTEST(4),XMUI(4),FRCPMU(4),HRTERM,SLIP(4),
     3              SLIPT(4),RHOS(4),EPSS(4),TERMP(4),TERMB(4),TERM(4),
     4              EPSSFC,FSXFAC(4),FSYFAC(4),FSZFAC(4),FRXFAC(4),
     5              FRYFAC(4),FRZFAC(4),FCXFAC(4),FCYFAC(4),FCZFAC(4),
     6              SFCDTR(4),SFSDTR(4),SFRCPR(4),SSLIP(4),FCAV(4),
     7              FSAV(4),FRCPAV(4),SLIPAV(4),RPSSM(4),FCSLSM(4),
     8          ARTQ6(4),TGFAC(4),ARFAC1(2),ARFAC2(2),RPSFA(2),RPSFB(2),
     9          RPSFC(2),RPSFD(2),HRPSFA(4),HRPSFB(4),HRPSFC(4),STEPD
      COMMON /COMP4/  XBRAK(16),IUVS(4),IUVB(4),IRPS,IDTCNT,ISTEP,ISTOP
      LOGICAL  IUVS,IUVB,IRPS
      COMMON/INPT5/ IBTYP(2),AK1,AK2,PONE,PTWO,PZERO(2),GN(16,2),ZETAB,
     1              CONE,CTWO,CTHREE,TAUA,TAUO(4),TLF(51),TTAU(51),
     2              TRPME(12),TWOT(12),TCT(12),TT(101),TPC(101),TTR(101)
     3             ,TTS(101),BTLF,ETLF,DTLF,NTLF,BRPM,ERPM,NRPM,
     4              BTT,ETT,DTT,NTT1,NTT2,NTT3,NTTS,XINPT5(9)
      COMMON/COMP5/ TAU(4),TQD(2),TQB(4),PP(2),TLAMB(2),PC,RWDRIV,JDEND,
     1              NDTYP,ARFAC3(2),RPSFE(2),RHOSMX(3),SLIPMX(3),SLIPP,
     2              RHOMAX,RHOSAV(4),SRHOS(4),UGW(4),ABSUGW(4),VECS,
     3              DELTAE,PIO15R,COMEN5,TQE,RPMF
      COMMON /INTR/ NEQR,TIMR,DTR,VARR(12),DERR(12)
      DIMENSION RPSI(4),DRPSI(4)
      EQUIVALENCE(VARR(1),RPSI(1)),(DERR(1),DRPSI(1))
      COMMON /INSUS/ XIF,RHOF,TSF,PHIFO,PHIFOD,DEL40,DEL40D,ISUS,
     1                AKDS,AKDS1,AKDS2,AKDS3,PHIRC(50),DTHF(50),DTHR(50),
     2                NCAMF,NCAMR,NDTHF,NDTHR
      COMMON /SUSCMP/ XMURO2,BXMRO2,XMTRO4,ZFO,TSFO2,RHOF2,RHFMUF,
     1                 RHF2MF,RF2MFI,RTF,RRTR,D3PD4,D3MD4,D43,DD3P4,
     2                 DD3M4,ZFD1RF,ZRD34,RFPF,RPF2M,WFMF,PHFP,PHIF2,
     3                 PHIFD2,RPHFD,ZFD1,ZFD2,ZRD4,TPF,SLOPE3,SLOPE4,
     4                 PHI3D,PHI4D,DTHF1,DTHF2,DTHR3,DTHR4,DTDD1,
     5                 DTDD2,DTDD3,DTDD4,FJF(4),SNPF
      COMMON/DRIVTT/TPATH,DELPTH,TCTEST(6),ITESTT,ITCHNG,IPATHT,IDRIVE,
     1              IDRVER,IBUG
C        IPATHT - STOP FOR DRIVER MODEL
C        IDRIVE - NOT ZERO, SAMPLE TIME FOR DRIVER MODEL
C        ITCHNG - NOT ZERO, CHANGE DESIRED SPEED AND DISTANCE
C        ITESTT,TCTEST(6) - INDEX AND INPUT TIMES FOR SPEED CHANGES
      COMMON/DRIVI/NEN,EMDT,ES,DS,APDMAX,FKDO,FKPO,FKS10,FKS20,FKSKDO,
     1            TESTBO,TSTS10,TSTS20,TSTR10,TSTR20,OMEGAO,TAUF,TIL,
     2            TL,S(5,2),NTRAN,YTRANS(6),GEAR1,GEAR2,GEAR3,GEAR4,
     3            VGR12,VGR23,VGR34,VGR43,VGR32,VGR21,
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     4              TESTT(5),DESSI(5),DIST1(5),PSIFHO,XIMPOR(9),
     5              BFP1,BFP2,DRIEND
      COMMON/DRIVE/EN,FKD,FKP,FKS1,FKS2,FKSKID,TESTB,TESTS1,TESTS2,
     1              TESTR1,TESTR2,THESKD,FBRK,APB,DSDES,
     2              TRKIN,TMT,DESS,DIST,DISTC,CONMPH,UT,UTMPH,
     3              APD,DELTAX,DELTV,TJ,TTEM,TTPSIT,PSISKD,ST,STSC2,QAY,
     4              AXP,AYP,D1,UP,XVP,YVP,SLOPE,SLOPER,PSIJ,XINT,X,Y,
     5              TERMX,TERMY,TEMPOR,AE,EI,EWT,AREI(7),ARCAPE(7),ET,
     6              PSIFFH,TITE,DPSISF,DPSILF,PSIM,APSI,APSIM,IPD(10),
     7              PPD(10),NPD,KCOUNT,ISKIDP,ISMAIN,IGEAR,WEIGHT(10),
     8              DEND
      COMMON/NEWCRB/ YC3P,YC4P,YC5P,YC6P,YCLP,
     1                ZC3P,ZC4P,ZC5P,ZC6P,ZCLP,
     2                PHIC3,PHIC4,PHIC5,PHIC6,NCRBSL,
     3                TANPC3,TANPC4,TANPC5,TANPC6,TANPCL,
     4                PHIC3R,PHIC4R,PHIC5R,PHIC6R,PHICLR,
     5                YCMP(6),ZCMP(6),PHICM(6)
      COMMON /RUFNES/ DELG,DGMAX,NEND,IRUF
      DIMENSION FJPP(35)
C
C      VARIABLES NO LONGER USED INCLUDE TQF(50),TQR(50),TI(4),TIHI(4)
C
C
C        SUBROUTINES DVDCHK AND DATE ARE RELATED TO THE OPERATING SYSTEM
C             AT OUR INSTALLATION
C       SUBROUTINE DVDCHK CAN CAUSE HALT ON ATTEMPTED DIVIDE BY ZERO,
C           EXPONENT OVERFLOW, AND MESSAGE ON EXPONENT UNDERFLOW.
C         THE SERVICES GIVEN BY SUBROUTINE DVDCHK CAN NOW GIVEN BY
C             FORTRAN EXTENDED ERROR HANDLING
C       SUBROUTINE DATE RETURNS THE CURRENT DATE IN EIGHT  CHARACTERS.
C
      CALL CLEAR(VHED(1),NPAGE(20))
      CALL CLEAR(TPATH,IBUG)
      CALL CLEAR(PHIO,PQRMIN)
      CALL CLEAR(YC1P,PSIFDO)
      CALL CLEAR( AKFC,END3)
      CALL CLEAR(APFR(1,1),NAPR)
      CALL CLEAR(AKT(1),FJP(35,4))
      CALL CLEAR(ITIR(1),ITIR(4))
      CALL CLEAR (FIDJ(1),COMEN4)
      CALL CLEAR(IBTYP(1),XINPT5(9))
      CALL CLEAR(XIF,NDTHR)
      CALL CLEAR(NEN,DRIEND)
      CALL CLEAR(YC3P,PHICM(6))
      CALL CLEAR(DELG,IRUF)
C
      ARBRF = 1.0
      ARBRR = 1.0
      CALL DVDCHK
    1 CALL CLEAR(NEQ,DER(50))
      CALL CLEAR(SUMM,LLL)
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      CALL CLEAR(FRSP(1),FRCP(4))
      CALL CLEAR(DPSINT,XMUGI(4))
      CALL CLEAR(XINDN,ENDEIN)
      CALL CLEAR(U1,XTRA(300))
      CALL CLEAR(X1P,CGH(4))
      CALL CLEAR(A234(1),A23(4))
      CALL CLEAR (FIDAR(1),ISTOP)
      CALL CLEAR(TAU(1),RPME)
      CALL CLEAR(NEQR,DERR(12))
      CALL CLEAR(XMURO2,SNPF)
      CALL CLEAR(EN,DEND)
C
C       SET IDRIVE = 1 IN DRVCNS AT BEGINNING OF COMPUTATION
C       SET ITESTT = 2 IN DRVCNS AND INITIALIZE DESS AND DIST
C       SET TCTEST(I),I=1,5  TO INPUT VALUES. TCTEST(6)SET LARGE VALUE.
C       SET ITCHNG = 0 FOR FIRST INTERVAL
C       SUBROUTINE DRIVER WILL DETERMINE PSII DURING FIRST INTERVAL
      DO 99 I=1,6
   99 TCTEST(I) = 1.0E20
      TPATH = 1.0E20
      DELPTH = 0.0
C       SET TPATH AND DELPTH TO INPUT VALUES IN DRVCNS
C       TPATH AND DELTPH ARE CONTROLS FOR DRIVER SAMPLING USED TO
C       RESET THE INDICATOR IDRIVE.
C
      IRPS = .FALSE.
      CALL INPUT
      CALL DATE(DADE)
      IF(IRUF.NE.0) CALL RUFRED(NEND,DELG,DGMAX,ZGP)
      IF(INDCRB.NE.1.AND.IRUF.EQ.0) GO TO 10
      NFJP = (RWHJE-RWHJB)/DRWHJ + 1.2
      DO 11 I=1,4
      IF(I.EQ.1) GO TO 12
      IM = I-1
      DO 15 K=1,IM
      IF(ITIR(I).EQ.ITIR(K)) GO TO 16
   15 CONTINUE
   12 CALL WHEEL(AKT(I),SIGT(I),XLAMT(I),RWHJB,RWHJE,DRWHJ,NFJP,
     1           RW(I),FJPP,35)
      DO 13 J=1,NFJP
   13 FJP(J,I) = FJPP(J)
      GO TO 11
   16 DO 17 J=1,NFJP
   17 FJP(J,I) = FJP(J,K)
   11 CONTINUE
   10 CONTINUE
      IF(ZF.EQ.0.0.AND.ZR.EQ.0.0) CALL INITEQ
      CALL CNSTNT
      IF(IDRVER.NE.0) CALL DRVCNS
      CALL IDOUT
      TCTEST(6) = 1.0E20
```

```
  100 DO 101  I=1,4
      LCB1(I) = .FALSE.
      LCB2(I) = .FALSE.
  101 CONTINUE
      TPRINT = TO
      THETMX = ABS(THMAX) * RAD
      UVWM2 = UVWMIN**2
      PQRM2 = PQRMIN**2
       UVWM2 = SIGN(UVWM2,UVWMIN)
       PQRM2 = SIGN(PQRM2,PQRMIN)
      ICBHIT = 0
      JCBHIT = 0
      IHIT = 0
      IND = 0
      T = TO
      DT = DTCOMP
      NEQ = 22
      NEQR  = 4
      PSIMAX = 135.0*RAD
      CALL PLOTTP(1)
      CALL OUTPUT(0)
C      ISTEP FOR COUNT OF OUTER INTEGRATION STEP FOR USE IN 'NESTED SUM'
    2 ISTEP = 0
      CALL PINT1(1,MODE,NEQ,T,DT,U,DU,EBAR)
      IDRIVE = 0
      IF (ISTOP.NE. 0) GO TO 6
    3 IF(TPRINT.GT.T+.1*DT) GO TO 4
      CALL OUTPUT(1)
      TPRINT = TPRINT+DTPRNT
      CALL PLOTTP(2)
    4 IDRIVE = 0
      IF(TPATH.GT. T+0.1*DT) GO TO 40
C          SUBROUTINE DRIVER WILL DETERMINE PSI1 DURING FIRST INCREMENT
C          TO AVOID, INITIALIZE TPATH ABOVE AS TO+DELPTH
      IDRIVE = 1
      TPATH = TPATH + DELPTH
      ITCHNG = 0
      IF(TCTEST(ITESTT).GT.(T+0.1*DT)) GO TO 41
      ITCHNG = 1
      ITESTT = ITESTT+1
C        AT DRIVER SAMPLE TIME, TEST THE TIME FOR CHANGING DESIRED
C        SPEED AND DISTANCE. FIRST VALUE OF TCTEST SHOULD BE EQUAL TO
C         TO AND FIRST VALUE OF DESIRED SPEED SHOULD BE U0.
   41 CONTINUE
   40 ISTEP = 0
      CALL PINT1(2,MODE,NEQ,T,DT,U,DU,EBAR)
      IF (ISTOP.NE. 0) GO TO 6
C          THETTL,PHITL,PSITL ARE VALUES OF THETT,PHIT,PSIT FROM PREVIOU
C           TIME INTERVAL, USED TO TEST NEW ANGLES     IN SUBROUTINE TMC
      THETTL = THETT
      PHITL  = PHIT
```

```
      PSITL  = PSIT
C     CALL EGYSUM   FORMERLY USED IN SPRUNG MASS IMPACT VERSION
      IF(T.GE.T1) GO TO 6
      IF(U**2+V**2+W**2.LE.UVWM2.AND.P2+Q2+R2.LE.PQRM2) GO TO 6
      IF(ABS(PHIT).GE.PIO2) GO TO 6
      IF(IPATHT .NE. 0) GO TO 6
      IF(ABS(THETTP).LT.THETMX) GO TO 5
C      XINDL IS PREVIOUS VALUE OF XINDN. XINDL INITIALLY ZERO GETS BNMTX
C             XINDN.NE.0.0 FOR THETAO OR PHIO .NE.0.0, OR AFTER INDEXING
C             THAT IS  THETN OR PHIN NOW .NE. 0.0
C             USED IN MAIN PROGRAM AND IN SUBROUTINES CNSTNT,TMCNST
      THETN = THETT
      THETTP= 0.0
      PHIN  = PHIT
      PHITP = 0.0
      PSIN  = PSIT
      PSITP = 0.0
      XINDL = XINDN
      XINDN = XINDN + 1.0
C     IND=1  INDICATOR FOR RE-INITIALIZATION IN PINT1
      IND = 1
    5 IF(INDCRB.EQ.0) GO TO 56
   50 DO 51  I=1,4
      IF(.NOT.LCB2(I)) GO TO 53
   51 CONTINUE
      ICBHIT = 2
   52 IF(ICBHIT.EQ.JCBHIT) GO TO 56
      JCBHIT = ICBHIT
      IND = 1
      DT = DTCOMP
      GO TO 56
   53 DO 54  I=1,4
      IF(LCB1(I)) GO TO 55
   54 CONTINUE
      ICBHIT = 0
      GO TO 52
   55 ICBHIT = 1
      IHIT = 1
      IF (ICBHIT.EQ.JCBHIT) GO TO 56
      JCBHIT = ICBHIT
      IND = 0
      DT = DELTC
      GO TO 2
C
   56 CONTINUE
   58 IF(IND.EQ.0) GO TO 3
      IND = 0
      GO TO 2
C
    6 CALL OUTPUT(1)
      CALL PLOTTP(3)
```

```
      IF(ISTOP .NE. 0) WRITE(6,59) ISTOP                                  MAIN3560
   59 FORMAT(17H    ERROR, ISTOP = ,  I3)                                 MAIN3570
C       CALL PLOTTP(3) CAUSES DISTINCTIVE RECORD ON TAPE FOR END OF RUN.MAIN3580
      GO TO 1                                                             MAIN3590
      END                                                                 MAIN3600
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      SUBROUTINE ADJTQB
C              HVOSM-VD2 VERSION
C              REVISED OCTOBER 1975   CALSPAN CORPORATION
      COMMON /DIMV/X1P,X2P,X3P,X4P,Y1P,Y2P,Y3P,Y4P,Z1P,Z2P,Z3P,Z4P,PHI1,
     1             PHI2,PHI3,PHI4,PSI1,PSI2,PSI3,PSI4,CAYW(4),CBYW(4),
     2             CGYW(4),ZPGI(4),THGI(4),PHGI(4),CPG(4),SPG(4),CTG(4),
     3             STG(4),CAGZ(4),CBGZ(4),CGGZ(4),D1(4),D2(4),D3(4),
     4             XLM1(4),XLM2(4),XLM3(4),AMTX(3,3),CMTX(3,4),XGPP(4),
     5             YGPP(4),ZGPP(4),DMATX(10,11),DELTA(4),CAR(4),CBR(4),
     6             CGR(4),FR(4),HI(4),FC(4),TI(4),AX(4),BX(4),CX(4),
     7             CTXG(4),UG(4),STXG(4),AY(4),BY(4),CY(4),CPYG(4),
     8             SPYG(4),VG(4),PSIIP(4),PHICI(4),CAC(4),CBC(4),CGC(4),
     9             FCXU(4),FCYU(4),FCZU(4),FS(4),CAXW(4),CBXW(4),CGXW(4)
      COMMON /DIMV/AS(4),BS(4),CS(4),CAS(4),CBS(4),CGS(4),BETP(4),
     1             BETBR(4),FSXU(4),FSYU(4),FSZU(4),FRXU(4),FRYU(4),
     2             FRZU(4),FXU(4),FYU(4),FZU(4),SI(4),F1FI(2),F1RI(2),
     3             F2FI(2),F2RI(2),CAH(4),CBH(4),CGH(4)
      DIMENSION XP(4),YP(4),ZP(4),PHII(4),PSII(4)
      EQUIVALENCE (XP(1),X1P),(YP(1),Y1P),(ZP(1),Z1P),(PHII(1),PHI1),
     1            (PSII(1),PSI1)
      COMMON/INPT5/ IBTYP(2),AK1,AK2,PONE,PTWO,PZERO(2),GN(16,2),ZETAB,
     1              CONE,CTWO,CTHREE,TAUA,TAUO(4),TLF(51),TTAU(51),
     2              TRPME(12),TWOT(12),TCT(12),TT(101),TPC(101),TTR(101)
     3             ,TTS(101),BTLF,ETLF,DTLF,NTLF,BRPM,ERPM,NRPM,
     4              BTT,ETT,DTT,NTT1,NTT2,NTT3,NTTS,XINPT5(9)
      COMMON/COMP5/ TAU(4),TQD(2),TQB(4),PP(2),TLAMB(2),PC,RWDRIV,JDEND,
     1              NBTYP,ARFAC3(2),RPSFE(2),RHOSMX(3),SLIPMX(3),SLIPP,
     2              RHOMAX,RHOSAV(4),SRHOS(4),UGW(4),ABSUGW(4),VECS,
     3              DELTAE,PIO15R,COMEN5,TQE,RPME
      COMMON /INTR/ NEQR,TIMR,DTR,VARR(12),DERR(12)
      DIMENSION RPSI(4),DRPSI(4)
      EQUIVALENCE(VARR(1),RPSI(1)),(DERR(1),DRPSI(1))
C
C   SUBROUTINE FOR ADJUSTMENT OF TQB
C        CALLED BY SUBROUTINE DAUXR, WHICH IS CALLED BY SUBROUTINE TIRF
C
      XLAMB = TLAMB(JDEND)
      DO 60 I=1,4,2
      ARPS = ABS(RPSI(I))
      ARPS1 = ABS(RPSI(I+1))
      ITRA = 0
      IF(ARPS.LE.ZETAB.OR.ARPS1.LE.ZETAB) GO TO 12
      TQB(I) = -SIGN(TQB(I),RPSI(I))
   10 TQB(I+1) = -SIGN(TQB(I+1),RPSI(I+1))
      GO TO 60
   12 IF(ARPS.LE.ZETAB.AND.ARPS1.LE.ZETAB) GO TO 15
      ITRA = 1
      IF(ARPS.LE.ZETAB) ITRA=2
      GO TO (16,26), ITRA
```

```
15 IF((ABS(FC(I)*HI(I))/12.0).LT.ABS(TQB(I))) GO TO 25
16 TTTA = FC(I+1) * HI(I+1)
   TTTB = FC(I)   * HI(I)
   TTTC = 12.0 * TQB(I)
   TTTD = TQB(I+1)
   TTTE = RPSI(I)
   TTTF = RPSI(I+1)
   J = 1
   JJ = I + 1
   GO TO 40
25 IF((ABS(FC(I+1)*HI(I+1))/12.0).LT.ABS(TQB(I+1)))  GO TO 35
26 TTTA = FC(I)    * HI(I)
   TTTB = FC(I+1) * HI(I+1)
   TTTC = 12.0 * TQB(I+1)
   TTTD = TQB(I)
   TTTE = RPSI(I+1)
   TTTF = RPSI(I)
   J = I+1
   JJ = I
   GO TO 40
35 TQB(I) =(FC(I) * HI(I))/12.0
   TQB(I) = -ABS(TQB(I)) * SIGN(1.0,RPSI(I))
   TQB(I+1) = -(ABS(FC(I+1)*HI(I+1))/12.0) * SIGN(1.0,RPSI(I+1))
   GO TO 60
40 TTTXA = SIGN(1.0,TTTB)
   TTTXB = SIGN(1.0,TTTF)
   IF(ITRA.GT.0) GO TO 44
   IF(TTTXA*TTTXB.GT.0.0) GO TO 45
44 TQB(J) =  SIGN(TQB(J), -TTTE)
   GO TO 46
45 TQB(J) = 0.0
46 TTTXC = TTTA -  XLAMB *(TTTB - TTTC)
   TTTXD = SIGN(1.0,TTTXC)
   IF(TTTXD*SIGN(1.0,-TTTF) .GT. 0.0) GO TO 51
   TQB(JJ)=0.0
   GO TO 60
51 IF(ABS(TTTXC/12.0).LT.ABS(TTTD)) GO TO 55
   TQB(JJ) = SIGN(TQB(JJ),-TTTF)
   GO TO 60
55 TQB(JJ) = -ABS(TTTXC/12.0) * SIGN(1.0, TTTF)
60 CONTINUE
   RETURN
   END
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      SUBROUTINE BLK01(NBLK,NBCRD,NSEQ,NCARD,DUM,NERR)                  BLK10010
C          HVOSM-VD2 VERSION  .                                         BLK10020
C          REVISED OCTOBER 1975   CALSPAN CORPORATION                   BLK10030
      COMMON/HEAD/ VHED(20),CHED(20),GHED(20),SHED(20),THED(20),        BLK10040
     1             NPAGE(20)                                            BLK10050
      COMMON/INPT/PHIO,THETAO,PSIO,PO,QO,RO,XCOP,YCOP,ZCOP,UO,VO,WO,    BLK10060
     1            A,B,DEL10,DEL20,DEL30,PHIRO,DEL10D,DEL20D,DEL30D,     BLK10070
     2            PHIROD,TF,TR,ZF,ZR,RHO,AKRS,XMUR,                     BLK10080
     3            XMS,XMUF,XIX,XIY,XIZ,XIXZ,CF,AKF,XLAMF,OMEGF,CFP,EPSF,BLK10090
     4            RF,CR,AKR,XLAMR,OMEGR,CRP,EPSR,RR,TS,THMAX,DTCOMP,TO, BLK10100
     5            T1,DTCMP1,DTPRNT,MODE,EBAR,EM,AAA,HMAX,HMIN,BET,G,    BLK10110
     6            HED(36),DADE(3),XIR,X1,Y1,Z1,X2,Y2,Z2,PHIC(50),DELB,  BLK10120
     7            DELE,DDEL,NDEL,PSIF(50),TQF(50),TQR(50),TB,TE,TINCR,  BLK10130
     8            NZTAB,NZ5,XBDRY(4,5),PSBDRY(4,5),YBDRY(2,5),NBX(5),   BLK10140
     9            NBY(5),NTBL1,NTBL2,NTBL3,ZGP(21,21,5)                 BLK10150
      COMMON/INPT/XB(5),XE(5),XINCR(5),NX(5),YB(5),YE(5),YINCR(5),NY(5),BLK10160
     1         XXZGP5(21),YYZGP5(21),AMUG(5),PSBDRO(4,5),UVWMIN,PQRMIN  BLK10170
      COMMON/INPT1/YC1P,YC2P,ZC2P,DELTC,PHIC1,PHIC2,AMUC,XIPS,          BLK10180
     1             CPSP,OMGPS,AKPS,EPSPS,XPS,RWHJB,RWHJE,DRWHJ,INDCRB,  BLK10190
     2             PSIFIO,PSIFDO                                        BLK10200
      DIMENSION YCIP(2)                                                 BLK10210
      EQUIVALENCE (YCIP(1),YC1P)                                        BLK10220
      COMMON /INPT4/ FIDJ(2),FIWJ(2),ARBR(2),NXUGMU,NXFRCP,XXUGMU(6),   BLK10230
     A               XXFRCP(6),XMUMAT(6,6,4),XMXPMT(6,6,4),             BLK10240
     B               XMXSMT(6,6,4),SLIPMT(6,6,4),CT(4),XMUM(4),         BLK10250
     C               XMUXP(4),XMUXS(4),RRMC(4),RRM(4),COMEN4            BLK10260
      EQUIVALENCE (FIDJ(1),FIDJF),(FIDJ(2),FIDJR),(FIWJ(1),FIWJF)       BLK10270
      EQUIVALENCE (FIWJ(2),FIWJR),(ARBR(1),ARBRF),(ARBR(2),ARBRR)       BLK10280
      COMMON /INSUS/ XIF,RHOF,TSF,PHIFO,PHIFOD,DEL40,DEL40D,ISUS,       BLK10290
     1               AKDS,AKDS1,AKDS2,AKDS3,PHIRC(50),DTHF(50),DTHR(50),BLK10300
     2               NCAMF,NCAMR,NDTHF,NDTHR                            BLK10310
      COMMON/DRIVTT/TPATH,DELPTH,TCTEST(6),ITESTT,ITCHNG,IPATHT,IDRIVE, BLK10320
     1              IDRVER,IBUG                                         BLK10330
C       IPATHT - STOP FOR DRIVER MODEL                                  BLK10340
C       IDRIVE - NOT ZERO, SAMPLE TIME FOR DRIVER MODEL                 BLK10350
C       ITCHNG - NOT ZERO, CHANGE DESIRED SPEED AND DISTANCE            BLK10360
C       ITESTT,TCTEST(6) - INDEX AND INPUT TIMES FOR SPEED CHANGES      BLK10370
      COMMON/NEWCRB/ YC3P,YC4P,YC5P,YC6P,YCLP,                          BLK10380
     1               ZC3P,ZC4P,ZC5P,ZC6P,ZCLP,                          BLK10390
     2               PHIC3,PHIC4,PHIC5,PHIC6,NCRBSL,                    BLK10400
     3               TANPC3,TANPC4,TANPC5,TANPC6,TANPCL,                BLK10410
     4               PHIC3R,PHIC4R,PHIC5R,PHIC6R,PHICLR,                BLK10420
     5               YCMP(6),ZCMP(6),PHICM(6)                           BLK10430
      DIMENSION DUM(18)                                                 BLK10440
      DATA NBS/4/                                                       BLK10450
      NBT = NBCRD+1                                                     BLK10460
      IF(NBT.LT.1.OR.NBT.GT.NBS+1) GO TO 98                             BLK10470
      GO TO(100,101,102,103,104),NBT                                    BLK10480
      GO TO 98                                                          BLK10490
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100 IF(NCARD.NE.100) GO TO 98
    DO 10 I=1,18
 10 HED(I) = DUM(I)
    GO TO 99
101 IF(NCARD.NE.101) GO TO 98
    TO     = DUM(1)
    T1     = DUM(2)
    DTCOMP = DUM(3)
    DTPRNT = DUM(4)
    THMAX  = DUM(5)
    UVWMIN = DUM(6)
    PQRMIN = DUM(7)
    COMEN4 = DUM(8)
    GO TO 99
102 IF(NCARD.NE.102) GO TO 98
    ISUS = IFIX(DUM(1))
    INDCRB = IFIX(DUM(2))
    NCRBSL = IFIX(DUM(3))
    DELTC = DUM(4)
    IDRVER = IFIX(DUM(5))
    IBUG = IFIX(DUM(6))
    IO = 0
    IF(IDRVER.NE.0) IO = 1
    NPAGE(18) = IO
    NPAGE(20) = IO
    IF(INDCRB.NE.0) NPAGE(5) = 1
    GO TO 99
103 IF(NCARD.NE.103) GO TO 98
    MODE = DUM(1)
    EBAR = DUM(2)
    EM   = DUM(3)
    AAA  = DUM(4)
    HMAX = DUM(5)
    HMIN = DUM(6)
    BET  = DUM(7)
    GO TO 99
104 IF(NCARD.NE.104) GO TO 98
    NPAGE(4) = IFIX(DUM(1))
    NPAGE(6) = IFIX(DUM(2))
    NPAGE(7) = IFIX(DUM(3))
    NPAGE(8) = IFIX(DUM(4))
    NPAGE(9) = IFIX(DUM(5))
    NPAGE(10)= IFIX(DUM(6))
    NPAGE(14)= IFIX(DUM(7))
    NPAGE(19)= IFIX(DUM(8))
    GO TO 99
 98 NERR = 1
 99 RETURN
    END
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      SUBROUTINE BLK02(NBLK,NBCRD,NSEQ,NCARD,DUM,NERR)                  BLK20010
C              HVOSM-VD2 VERSION                                        BLK20020
C              REVISED OCTOBER 1975   CALSPAN CORPORATION               BLK20030
      COMMON/HEAD/ VHED(20),CHED(20),GHED(20),SHED(20),THED(20),        BLK20040
     1            NPAGE(20)                                             BLK20050
      COMMON/INPT/PHIO,THETAO,PSIO,PO,QO,RO,XCOP,YCOP,ZCOP,UO,VO,WO,    BLK20060
     1           A,B,DEL10,DEL20,DEL30,PHIRO,DEL10D,DEL20D,DEL30D,      BLK20070
     2           PHIROD,TF,TR,ZF,ZR,RHO,AKRS,XMUR,                      BLK20080
     3           XMS,XMUF,XIX,XIY,XIZ,XIXZ,CF,AKF,XLAMF,OMEGF,CFP,EPSF,BLK20090
     4           RF,CR,AKR,XLAMR,OMEGR,CRP,EPSR,RR,TS,THMAX,DTCOMP,TO,  BLK20100
     5           T1,DTCMP1,DTPRNT,MODE,FBAR,EM,AAA,HMAX,HMIN,BET,G,     BLK20110
     6           HED(36),DADE(3),XIR,X1,Y1,Z1,X2,Y2,Z2,PHIC(50),DELB,   BLK20120
     7           DELE,DDEL,NDEL,PSIF(50),TQF(50),TQR(50),TB,TE,TINCR,   BLK20130
     8           NZTAB,NZ5,XBDRY(4,5),PSBDRY(4,5),YBDRY(2,5),NBX(5),    BLK20140
     9           NBY(5),NTBL1,NTBL2,NTBL3,ZGP(21,21,5)                  BLK20150
      COMMON/INPT/XB(5),XE(5),XINCR(5),NX(5),YB(5),YE(5),YINCR(5),NY(5),BLK20160
     1         XXZGP5(21),YYZGP5(21),AMUG(5),PSBDRO(4,5),UVWMIN,PQRMIN BLK20170
      COMMON/INPT1/YC1P,YC2P,ZC2P,DELTC,PHIC1,PHIC2,AMUC,XIPS,          BLK20180
     1            CPSP,OMGPS,AKPS,EPSPS,XPS,RWHJB,RWHJE,DRWHJ,INDCRB,   BLK20190
     2            PSIFIO,PSIFDO                                         BLK20200
      DIMENSION YC1P(2)                                                 BLK20210
      EQUIVALENCE (YCIP(1),YC1P)                                        BLK20220
      COMMON/INPT3/ AKFC,AKFCP,OMEGFC,AKFE,AKFEP,OMEGFE,AKRC,AKRCP,     BLK20230
     1             OMEGRC,AKRE,AKREP,OMEGRE,END3                        BLK20240
      COMMON/APTABL/ APFR(21,2),IAPFR(2),DAPFB,DAPFE,DDAPF,NAPF,        BLK20250
     1              DAPRB,DAPRE,DDAPR,NAPR                              BLK20260
      DIMENSION APF(21),APR(21)                                         BLK20270
      EQUIVALENCE (APFR(1,1),APF(1)),(APFR(1,2),APR(1))                 BLK20280
      COMMON /INPT4/ FIDJ(2),FIWJ(2),ARBR(2),NXUGMU,NXFRCP,XXUGMU(6),   BLK20290
     A              XXFRCP(6),XMUMAT(6,6,4),XMXPMT(6,6,4),              BLK20300
     B              XMXSMT(6,6,4),SLIPMT(6,6,4),CT(4),XMUM(4),          BLK20310
     C              XMUXP(4),XMUXS(4),RRMC(4),RRM(4),COMEN4             BLK20320
      EQUIVALENCE (FIDJ(1),FIDJF),(FIDJ(2),FIDJR),(FIWJ(1),FIWJF)       BLK20330
      EQUIVALENCE (FIWJ(2),FIWJR),(ARBR(1),ARBRF),(ARBR(2),ARBRR)       BLK20340
      COMMON/INPT5/ IBTYP(2),AK1,AK2,PONE,PTWO,PZERO(2),GN(16,2),ZETAB, BLK20350
     1             CONE,CTWO,CTHREE,TAUA,TAUO(4),TLF(51),TTAU(51),      BLK20360
     2             TRPME(12),TWOT(12),TCT(12),TT(101),TPC(101),TTR(101)BLK20370
     3            ,TTS(101),BTLF,ETLF,DTLF,NTLF,BRPM,ERPM,NRPM,         BLK20380
     4             BTT,ETT,DTT,NTT1,NTT2,NTT3,NTTS,XINPT5(9)            BLK20390
      COMMON /INSUS/ XIF,RHOF,TSF,PHIFO,PHIFOD,DEL40,DEL40D,ISUS,       BLK20400
     1              AKDS,AKDS1,AKDS2,AKDS3,PHIRC(50),DTHF(50),DTHR(50),BLK20410
     2              NCAMF,NCAMR,NDTHF,NDTHR                             BLK20420
      DIMENSION DUM(18)                                                 BLK20430
      DATA NBS/17/                                                      BLK20440
      NBT=NBCRD+1                                                       BLK20450
      IF(NBT.LT.1.OR.NBT.GT.NBS+1) GO TO 98                             BLK20460
      GO TO(200,201,202,203,204,205,206,207,208,209,210,211,212,213,214,BLK20470
     1     215,216,217),NBT                                             BLK20480
      GO TO 98                                                          BLK20490
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200 IF(NCARD.NE.200) GO TO 98
    DO 10 I=1,18
 10 VHED(I) = DUM(I)
    GO TO 99
201 IF(NCARD.NE.201) GO TO 98
    XMS  = DUM(1)
    XMUF = DUM(2)
    XMUR = DUM(3)
    XIX  = DUM(4)
    XIY  = DUM(5)
    XIZ  = DUM(6)
    XIXZ = DUM(7)
    XIR  = DUM(8)
    XIF = DUM(9)
    GO TO 99
202 IF(NCARD.NE.202) GO TO 98
    A    = DUM(1)
    B    = DUM(2)
    TF   = DUM(3)
    TR   = DUM(4)
    RHO  = DUM(5)
    TS = DUM(6)
    RHOF = DUM(7)
    TSF = DUM(8)
    G = 386.4
    IF(DUM(9).NE.0.0) G = DUM(9)
    GO TO 99
203 IF(NCARD.NE.203) GO TO 98
    X1 = DUM(1)
    Y1 = DUM(2)
    Z1 = DUM(3)
    X2 = DUM(4)
    Y2 = DUM(5)
    Z2 = DUM(6)
    DO 30 J=1,6
    IF(DUM(J).NE.0.0) NPAGE(16) = 1
 30 CONTINUE
    ZF = DUM(7)
    ZR = DUM(8)
    GO TO 99
204 IF(NCARD.NE.204) GO TO 98
    AKF     = DUM(1)
    AKFC    = DUM(2)
    AKFCP   = DUM(3)
    AKFE    = DUM(4)
    AKFEP   = DUM(5)
    XLAMF   = DUM(6)
    OMEGFC  = DUM(7)
    OMEGFE  = DUM(8)
    GO TO 99
205 IF(NCARD.NE.205)GO TO 98
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      AKR    = DUM(1)
      AKRC   = DUM(2)
      AKRCP  = DUM(3)
      AKRE   = DUM(4)
      AKREP  = DUM(5)
      XLAMR  = DUM(6)
      OMEGRC = DUM(7)
      OMEGRE = DUM(8)
      GO TO 99
  206 IF(NCARD.NE.206) GO TO 98
      CF   = DUM(1)
      CFP  = DUM(2)
      EPSF = DUM(3)
      CR   = DUM(4)
      CRP  = DUM(5)
      EPSR = DUM(6)
      GO TO 99
  207 IF(NCARD.NE.207) GO TO 98
      RF = DUM(1)
      RR = DUM(2)
      AKRS = DUM(3)
      AKDS = DUM(4)
      AKDS1 = DUM(5)
      AKDS2 = DUM(6)
      AKDS3 = DUM(7)
      GO TO 99
  208 IF(NCARD.NE.208) GO TO 98
      XIPS  = DUM(1)
      CPSP  = DUM(2)
      OMGPS = DUM(3)
      AKPS  = DUM(4)
      EPSPS = DUM(5)
      XPS   = DUM(6)
      GO TO 99
  209 IF(NCARD.NE.209.OR.NSEQ.NE.0) GO TO 98
      DELB = DUM(1)
      DELE = DUM(2)
      DDEL = DUM(3)
      NDTHF = DUM(4)
      NDTHR = DUM(5)
      NDEL = (DELE-DELB)/DDEL +1
      NCRDS = (NDEL-1)/9 + 1
      CALL TREAD(NCARD,NCRDS,NDEL,50,PHIC,NERR)
      IF(NERR.NE.0) GO TO 98
      IF(ISUS.EQ.1) CALL TREAD(NCARD,NCRDS,NDEL,50,PHIRC,NERR)
      IF(NERR.NE.0) GO TO 98
      IF(NDTHF.NE.0) CALL TREAD(NCARD,NCRDS,NDEL,50,DTHF,NERR)
      IF(NERR.NE.0) GO TO 98
      IF(NDTHR.NE.0) CALL TREAD(NCARD,NCRDS,NDEL,50,DTHR,NERR)
      IF(NERR.NE.0) GO TO 98
      GO TO 99
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210 IF(NCARD.NE.210.OR.NSEQ.NE.0) GO TO 98                        BLK21520
    DAPFB = DUM(1)                                                BLK21530
    DAPFE = DUM(2)                                                BLK21540
    DDAPF = DUM(3)                                                BLK21550
    NAPF = (DAPFE-DAPFB)/DDAPF + 1                                BLK21560
    NCRDS = (NAPF-1)/9 + 1                                        BLK21570
    CALL TREAD(NCARD,NCRDS,NAPF,21,APF,NERR)                      BLK21580
    IAPFR(1) = 1                                                  BLK21590
    IF(NERR.NE.0) GO TO 98                                        BLK21600
    GO TO 99                                                      BLK21610
211 IF(NCARD.NE.211.OR.NSEQ.NE.0) GO TO 98                        BLK21620
    DAPRB = DUM(1)                                                BLK21630
    DAPRE = DUM(2)                                                BLK21640
    DDAPR = DUM(2)                                                BLK21650
    NAPR = (DAPRE-DAPRB)/DDAPR + 1                                BLK21660
    NCRDS = (NAPF-1)/9 + 1                                        BLK21670
    CALL TREAD(NCARD,NCRDS,NAPR,21,APR,NERR)                      BLK21680
    IAPFR(2) = 1                                                  BLK21690
    IF(NERR.NE.0)GO TO 98                                         BLK21700
    GO TO 99                                                      BLK21710
212 IF(NCARD.NE.212) GO TO 98                                     BLK21720
    FIDJF = DUM(1)                                                BLK21730
    FIWJF = DUM(2)                                                BLK21740
    FIDJR = DUM(3)                                                BLK21750
    FIWJR = DUM(4)                                                BLK21760
    ARBRF = DUM(5)                                                BLK21770
    ARBRR = DUM(6)                                                BLK21780
    IF(ARBRF.EQ.0.0) ARBRF = 1.0                                  BLK21790
    IF(ARBRR.EQ.0.0) ARBRR = 1.0                                  BLK21800
    GO TO 99                                                      BLK21810
213 IF(NCARD.NE.213) GO TO 98                                     BLK21820
    AK1 = DUM(1)                                                  BLK21830
    AK2 = DUM(2)                                                  BLK21840
    PONE = DUM(3)                                                 BLK21850
    PTWO = DUM(4)                                                 BLK21860
    PZERO(1) = DUM(5)                                             BLK21870
    PZERO(2) = DUM(6)                                             BLK21880
    ZETAB = DUM(7)                                                BLK21890
    GO TO 99                                                      BLK21900
214 IF(NCARD.NE.214.OR.NSEQ.NE.0) GO TO 98                        BLK21910
    IBTYP(1) = DUM(1)                                             BLK21920
    IBTYP(2) = DUM(2)                                             BLK21930
    CALL T2READ(NCARD,16,16,2,GN,NERR)                            BLK21940
    IF(NERR.NE.0) GO TO 98                                        BLK21950
    GO TO 99                                                      BLK21960
215 IF(NCARD.NE.215.OR.NSEQ.NE.0) GO TO 98                        BLK21970
    BRPM = DUM(1)                                                 BLK21980
    ERPM = DUM(2)                                                 BLK21990
    DRPM = DUM(3)                                                 BLK22000
    NRPM = (ERPM-BRPM)/DRPM + 1.2                                 BLK22010
    NCRDS = (NRPM-1)/9 + 1                                        BLK22020
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      CALL TREAD(NCARD,NCRDS,NRPM,12,TWOT,NERR)                         BLK22030
      IF(NERR.NE.0) GO TO 98                                            BLK22040
      CALL TREAD(NCARD,NCRDS,NRPM,12,TCT,NERR)                          BLK22050
      IF(NERR.NE.0) GO TO 98                                            BLK22060
      GO TO 99                                                          BLK22070
  216 IF(NCARD.NE.216.OR.NSEQ.NE.0) GO TO 98                            BLK22080
      BTLF = DUM(1)                                                     BLK22090
      ETLF = DUM(2)                                                     BLK22100
      DTLF = DUM(3)                                                     BLK22110
      NTLF = (ETLF-BTLF)/DTLF + 1.2                                     BLK22120
      NCRDS = (NTLF-1)/9 + 1                                            BLK22130
      CALL TREAD(NCARD,NCRDS,NTLF,51,TLF,NERR)                          BLK22140
      IF(NERR.NE.0) GO TO 98                                            BLK22150
      GO TO 99                                                          BLK22160
  217 IF(NCARD.NE.217) GO TO 98                                         BLK22170
      CONE = DUM(1)                                                     BLK22180
      CTWO = DUM(2)                                                     BLK22190
      CTHREE = DUM(3)                                                   BLK22200
      GO TO 99                                                          BLK22210
   98 NERR= 1                                                           BLK22220
   99 RETURN                                                            BLK22230
      END                                                               BLK22240
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      SUBROUTINE BLK03(NBLK,NBCRD,NSEQ,NCARD,DUM,NERR)
C              HVOSM-VD2 VERSION
C              REVISED OCTOBER 1975   CALSPAN CORPORATION
      COMMON/HEAD/ VHED(20),CHED(20),GHED(20),SHED(20),THED(20),
     1             NPAGE(20)
      COMMON/INPT1/YC1P,YC2P,ZC2P,DELTC,PHIC1,PHIC2,AMUC,XIPS,
     1             CPSP,OMGPS,AKPS,EPSPS,XPS,RWHJB,RWHJE,DRWHJ,INDCRB,
     2             PSIFIO,PSIFDC
      DIMENSION YC1P(2)
      EQUIVALENCE (YC1P(1),YC1P)
      COMMON /TIRIN/ AKT(4),SIGT(4),XLAMT(4),A0(4),A1(4),A2(4),A3(4),
     1               A4(4),OMEGT(4),AMU(4),RW(4),FJP(35,4),A234(4),
     2               A12(4),OM12A2(4),OM12M1(4),A23(4),ITIR(4)
      COMMON /INPT4/ FIDJ(2),FIWJ(2),ARBR(2),NXUGMU,NXFRCP,XXUGMU(6),
     A               XXFRCP(6),XMUMAT(6,6,4),XMXPMT(6,6,4),
     B               XMXSMT(6,6,4),SLIPMT(6,6,4),CT(4),XMUM(4),
     C               XMUXP(4),XMUXS(4),RRMC(4),RRM(4),COMEN4
      EQUIVALENCE (FIDJ(1),FIDJF),(FIDJ(2),FIDJP),(FIWJ(1),FIWJF)
      EQUIVALENCE (FIWJ(2),FIWJR),(ARBR(1),ARBRF),(ARBR(2),ARBRR)
      DIMENSION DUM(18),TDUM(9,4)
      DIMENSION TDUM1(6,6),TDUM2(6,6),TDUM3(6,6),TDUM4(6,6)
      DATA NBS/6/
      NBT = NBCRD+1
      IF(NBT.LT.1.OR.NBT.GT.NBS+1) GO TO 98
      GO TO (300,301,302,303,304,305),NBT
      GO TO 98
  300 IF(NCARD.NE.300) GO TO 98
      DO 10 I=1,18
   10 THED(I) = DUM(I)
      GO TO 99
  301 IF(NCARD.NE.301) GO TO 98
      ITIR(1) = DUM(1)
      ITIR(2) = DUM(2)
      ITIR(3) = DUM(3)
      ITIR(4) = DUM(4)
      DO 319 I=1,4
  319 AMU(I) = DUM(5)
      RWHJE = DUM(6)
      DRWHJ = DUM(7)
      NXFRCP = IFIX(DUM(8))
      NXUGMU = IFIX(DUM(9))
      CALL TREAD(NCARD,1,NXFRCP,6,XXFRCP,NERR)
      IF(NERR.NE.0) GO TO 98
      CALL TREAD(NCARD,1,NXUGMU,6,XXUGMU,NERR)
      IF(NERR.NE.0) GO TO 98
      GO TO 99
  302 IF(NCARD.NE.302) GO TO 98
      NTIR = DUM(1)
      GO TO 320
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303 IF(NCARD.NE.303) GO TO 98                                    BLK30500
    NTIR = DUM(1)                                                BLK30510
    GO TO 320                                                    BLK30520
304 IF(NCARD.NE.304) GO TO 98                                    BLK30530
    NTIR = DUM(1)                                                BLK30540
    GO TO 320                                                    BLK30550
305 IF(NCARD.NE.305) GO TO 98                                    BLK30560
    NTIR = DUM(1)                                                BLK30570
320 CALL TREAD(NCARD,1,8,9,DUM,NERR)                             BLK30580
    IF(NERR.NE.0) GO TO 98                                       BLK30590
    DO 321 I=1,4                                                 BLK30600
    IF(ITIR(I).NE.NTIR) GO TO 321                                BLK30610
    AKT(I) = DUM(1)                                              BLK30620
    SIGT(I) = DUM(2)                                             BLK30630
    XLAMT(I) = DUM(3)                                            BLK30640
    A0(I) = DUM(4)                                               BLK30650
    A1(I) = DUM(5)                                               BLK30660
    A2(I) = DUM(6)                                               BLK30670
    A3(I) = DUM(7)                                               BLK30680
    A4(I) = DUM(8)                                               BLK30690
321 CONTINUE                                                     BLK30700
    CALL TREAD(NCARD,1,5,9,DUM,NERR)                             BLK30710
    IF(NERR.NE.0) GO TO 98                                       BLK30720
    DO 322 I=1,4                                                 BLK30730
    IF(ITIR(I).NE.NTIR) GOTO 322                                 BLK30740
    OMEGT(I) = DUM(1)                                            BLK30750
    RW(I) = DUM(2)                                               BLK30760
    XMUM(I) = DUM(3)                                             BLK30770
    CT(I) = DUM(4)                                               BLK30780
    RRMC(I) = DUM(5)                                             BLK30790
322 CONTINUE                                                     BLK30800
    CALL T2READ(NCARD,6,NXFRCP,NXUGMU,TDUM1,NERR)                BLK30810
    IF(NERR.NE.0) GO TO 98                                       BLK30820
    CALL T2READ(NCARD,6,NXFRCP,NXUGMU,TDUM2,NERR)                BLK30830
    IF(NERR.NE.0) GO TO 98                                       BLK30840
    CALL T2READ(NCARD,6,NXFRCP,NXUGMU,TDUM3,NERR)                BLK30850
    IF(NERR.NE.0) GO TO 98                                       BLK30860
    CALL T2READ(NCARD,6,NXFRCP,NXUGMU,TDUM4,NERR)                BLK30870
    IF(NERR.NE.0) GO TO 98                                       BLK30880
    DO 325 I=1,4                                                 BLK30890
    IF(ITIR(I).NE.NTIR) GO TO 325                                BLK30900
    DO 326 J=1,NXFRCP                                            BLK30910
    DO 326 K=1,NXUGMU                                            BLK30920
    XMUMAT(J,K,I) = TDUM1(J,K)                                   BLK30930
    XMXPMT(J,K,I) = TDUM2(J,K)                                   BLK30940
    XMXSMT(J,K,I) = TDUM3(J,K)                                   BLK30950
326 SLIPMT(J,K,I) = TDUM4(J,K)                                   BLK30960
325 CONTINUE                                                     BLK30970
    GO TO 99                                                     BLK30980
 98 NERR = 1.0                                                   BLK30990
 99 RETURN                                                       BLK31000
```

END BLK31010

```
      SUBROUTINE BLK04(NBLK,NBCRD,NSEQ,NCARD,DUM,NERR)
C               HVOSM-VD2 VERSION
C               REVISED OCTOBER 1975   CALSPAN CORPORATION
      COMMON/HEAD/ VHED(20),CHED(20),GHED(20),SHED(20),THED(20),
     1             NPAGE(20)
      COMMON/INPT/PHIO,THETAO,PSIO,PO,QO,RO,XCOP,YCOP,ZCOP,UO,VO,WO,
     1           A,B,DEL10,DEL20,DEL30,PHIRO,DEL10D,DEL20D,DEL30D,
     2           PHIROD,TF,TR,ZF,ZR,RHO,AKRS,XMUR,
     3           XMS,XMUF,XIX,XIY,XIZ,XIXZ,CF,AKF,XLAMF,OMEGF,CFP,EPSF,
     4           RF,CR,AKR,XLAMR,OMEGR,CRP,EPSR,RR,TS,THMAX,DTCOMP,TO,
     5           T1,DTCMP1,DTPRNT,MODE,EBAR,EM,AAA,HMAX,HMIN,BET,G,
     6           HED(36),DADE(3),XIR,X1,Y1,Z1,X2,Y2,Z2,PHIC(50),DELB,
     7           DELE,DDEL,NDEL,PSIF(50),TQF(50),TQR(50),TB,TE,TINCR,
     8           NZTAB,NZ5,XBDRY(4,5),PSBDRY(4,5),YBDRY(2,5),NBX(5),
     9           NBY(5),NTBL1,NTBL2,NTBL3,ZGP(21,21,5)
      COMMON/INPT/XB(5),XE(5),XINCR(5),NX(5),YB(5),YE(5),YINCR(5),NY(5),
     1        XXZGP5(21),YYZGP5(21),AMUG(5),PSBDRO(4,5),UVWMIN,PQRMIN
      COMMON/INPT5/ IBTYP(2),AK1,AK2,PONE,PTWO,PZERO(2),GN(16,2),ZETAB,
     1              CONE,CTWO,CTHREE,TAUA,TAUO(4),TLF(51),TTAU(51),
     2              TRPME(12),TWOT(12),TCT(12),TT(101),TPC(101),TTR(101)
     3             ,TTS(101),BTLF,ETLF,DTLF,NTLF,BRPM,ERPM,NRPM,
     4              BTT,ETT,DTT,NTT1,NTT2,NTT3,NTTS,XINPT5(9)
      COMMON/DRIVI/NEN,EMDT,ES,DS,APDMAX,FKDO,FKPO,FKS10,FKS20,FKSKDO,
     1             TESTBO,TSTS10,TSTS20,TSTR10,TSTR20,OMEGAO,TAUF,TIL,
     2             TL,S(5,2),NTRAN,YTRANS(6),GEAR1,GEAR2,GEAR3,GEAR4,
     3             VGR12,VGR23,VGR34,VGR43,VGR32,VGR21,
     4             TESTT(5),DESSI(5),DISTI(5),PSIFHO,XIMPOR(9),
     5             BFP1,BFP2,DRIEND
      COMMON/DRIVE/EN,FKD,FKP,FKS1,FKS2,FKSKID,TESTB,TESTS1,TESTS2,
     1             TESTR1,TESTR2,THESKD,FBRK,APB,DSDES,
     2             TRKIN,TMT,DESS,DIST,DISTC,CONMPH,UT,UTMPH,
     3             APD,DELTAX,DELTV,TJ,TTEM,TTPSIT,PSISKD,ST,STS02,QAY,
     4             AXP,AYP,DI,UP,XVP,YVP,SLOPE,SLOPER,PSIJ,XINT,X,Y,
     5             TERMX,TERMY,TEMPOR,AE,EI,EWT,AREI(7),ARCAPE(7),ET,
     6             PSIFFH,TITE,DPSISF,DPSILF,PSIM,APSI,APSIM,TPD(10),
     7             PPD(10),NPD,KCOUNT,ISKIDP,ISMAIN,IGEAR,WEIGHT(10),
     8             DEND
      DIMENSION DUM(18)
      DATA NBS/11/
      NBT = NBCRD+1
      IF(NBT.LT.1.OR.NBT.GT.NBS+1) GO TO 98
      GO TO (400,401,402,403,404,405,406,407,408,409,410,411),NBT
      GO TO 98
  400 IF(NCARD.NE.400) GO TO 98
      DO 10 I=1,18
   10 CHED(I) = DUM(I)
      GO TO 99
  401 IF(NCARD.NE.401.OR.NSEQ.NE.0) GO TO 98
      TB     = DUM(1)
```

```
      TE    = DUM(2)
      TINCR = DUM(3)
      NTBL1 = DUM(4)
      IF(NTBL1.EQ.0) GO TO 99
      NT = IFIX((TE-TB)/TINCR + 1.2)
      NCRDS = (NT-1)/9 + 1
      CALL TREAD(NCARD,NCRDS,NT,50,PSIF,NERR)
      IF(NERR.NE.0) GO TO 98
      GO TO 99
  402 IF(NCARD.NE.402.OR.NSEQ.NE.0) GO TO 98
      BTT = DUM(1)
      ETT = DUM(2)
      DTT = DUM(3)
      NTT1 = DUM(4)
      NTT2 = DUM(5)
      NTT3 = DUM(6)
      IF(NTT1+NTT2+NTT3.EQ.0) GO TO 99
      NTTS = IFIX((ETT-BTT)/DTT+1.2)
      NCRDS = (NTTS-1)/9+1
      IF(NTT1.EQ.0) GO TO 21
      NPAGE(18) = 1
      CALL TREAD(NCARD,NCRDS,NTTS,101,TPC,NERR)
      IF(NERR.NE.0) GO TO 98
   21 IF(NTT2.EQ.0) GO TO 22
      NPAGE(18) = 1
      CALL TREAD(NCARD,NCRDS,NTTS,101,TTS,NERR)
      IF(NERR.NE.0) GO TO 98
   22 IF(NTT3.EQ.0) GO TO 99
      CALL TREAD(NCARD,NCRDS,NTTS,101,TTR,NERR)
      IF(NERR.NE.0) GO TO 98
      GO TO 99
  403 IF(NCARD.NE.403) GO TO 98
      EMDT = DUM(1)
      EN = DUM(2)
      NEN = IFIX(EN)
      DS = DUM(3)
      TAUF = DUM(4)
      TIL = DUM(5)
      TL = DUM(6)
      TSTS10 = DUM(7)
      TSTS20 = DUM(8)
      TESTB0 = DUM(9)
      GO TO 99
  404 IF(NCARD.NE.404) GO TO 98
      TSTR10 = DUM(1)
      TSTR20 = DUM(2)
      APDMAX = DUM(3)
      FKD0 = DUM(4)
      FKS10 = DUM(5)
      FKS20 = DUM(6)
      FKSKD0 = DUM(7)
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      BFP1 = DUM(8)                                           BLK41010
      BFP2 = DUM(9)                                           BLK41020
      GO TO 99                                                BLK41030
  405 IF(NCARD.NE.405) GO TO 98                               BLK41040
      GEAR1 = DUM(1)                                          BLK41050
      GEAR2 = DUM(2)                                          BLK41060
      GEAR3 = DUM(3)                                          BLK41070
      GEAR4 = DUM(4)                                          BLK41080
      GO TO 99                                                BLK41090
  406 IF(NCARD.NE.406) GO TO 98                               BLK41100
      VGR12 = DUM(1)                                          BLK41110
      VGR23 = DUM(2)                                          BLK41120
      VGR34 = DUM(3)                                          BLK41130
      VGR43 = DUM(4)                                          BLK41140
      VGR32 = DUM(5)                                          BLK41150
      VGR21 = DUM(6)                                          BLK41160
      IF(VGR34.LT.VGR23) VGR34 = 10000.0                      BLK41170
      GO TO 99                                                BLK41180
  407 IF(NCARD.NE.407) GO TO 98                               BLK41190
      DO 4071 I=1,7                                           BLK41200
 4071 XIMPOR(I) = DUM(I)                                      BLK41210
      GO TO 99                                                BLK41220
  408 IF(NCARD.NE.408) GO TO 98                               BLK41230
      DO 4081 I=1,5                                           BLK41240
 4081 TESTT(I) = DUM(I)                                       BLK41250
      GO TO 99                                                BLK41260
  409 IF(NCARD.NE.409) GO TO 98                               BLK41270
      DO 4091 I=1,5                                           BLK41280
 4091 DESSI(I) = DUM(I)                                       BLK41290
      GO TO 99                                                BLK41300
  410 IF(NCARD.NE.410) GO TO 98                               BLK41310
      DO 4101 I=1,5                                           BLK41320
 4101 DISTI(I) = DUM(I)                                       BLK41330
      GO TO 99                                                BLK41340
  411 IF(NCARD.NE.411.OR.NSEQ.NE.0) GO TO 98                  BLK41350
      NTRAN = IFIX(DUM(1))                                    BLK41360
      CALL TREAD(NCARD,1,NTRAN,6,YTRANS,NERR)                 BLK41370
      IF(NERR.NE.0) GO TO 98                                  BLK41380
      CALL T2READ(NCARD,5,NTRAN,2,S,NERR)                     BLK41390
      IF(NERR.NE.0) GO TO 98                                  BLK41400
      GO TO 99                                                BLK41410
   98 NERR = 1                                                BLK41420
   99 RETURN                                                  BLK41430
      END                                                     BLK41440
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      SUBROUTINE BLK05(NBLK,NBCRD,NSEQ,NCARD,DUM,NERR)
C              HVOSM-VD2 VERSION
C              REVISED OCTOBER 1975   CALSPAN CORPORATION
      COMMON/HEAD/ VHED(20),CHED(20),GHED(20),SHED(20),THED(20),
     1             NPAGE(20)
      COMMON/INPT/PHIO,THETAO,PSIO,PO,QO,RO,XCOP,YCOP,ZCOP,UO,VO,WO,
     1            A,B,DEL10,DEL20,DEL30,PHIRO,DEL10D,DEL20D,DEL30D,
     2            PHIROD,TF,TR,ZF,ZR,RHO,AKRS,XMUP,
     3            XMS,XMUF,XIX,XIY,XIZ,XIXZ,CF,AKF,XLAMF,OMEGF,CFP,EPSF,
     4            RF,CR,AKR,XLAMR,OMEGR,CRP,EPSR,RR,TS,THMAX,DTCOMP,TO,
     5            T1,DTCMP1,DTPRNT,MODE,EBAR,EM,AAA,HMAX,HMIN,BET,G,
     6            HED(36),DADE(3),XIR,X1,Y1,Z1,X2,Y2,Z2,PHIC(50),DELB,
     7            DELE,DDEL,NDEL,PSIF(50),TQF(50),TQR(50),TB,TE,TINCR,
     8            NZTAB,NZ5,XBDRY(4,5),PSBDRY(4,5),YBDRY(2,5),NBX(5),
     9            NBY(5),NTBL1,NTBL2,NTBL3,ZGP(21,21,5)
      COMMON/INPT/XB(5),XE(5),XINCR(5),NX(5),YB(5),YE(5),YINCR(5),NY(5),
     1          XXZGP5(21),YYZGP5(21),AMUG(5),PSBDRO(4,5),UVWMIN,PQRMIN
      COMMON/INPT1/YC1P,YC2P,ZC2P,DELTC,PHIC1,PHIC2,AMUC,XIPS,
     1             CPSP,OMGPS,AKPS,EPSPS,XPS,RWHJB,RWHJE,DRWHJ,INDCRB,
     2             PSIFIO,PSIFDO
      COMMON/NEWCRB/ YC3P,YC4P,YC5P,YC6P,YCLP,
     1               ZC3P,ZC4P,ZC5P,ZC6P,ZCLP,
     2               PHIC3,PHIC4,PHIC5,PHIC6,NCRBSL,
     3               TANPC3,TANPC4,TANPC5,TANPC6,TANPCL,
     4               PHIC3R,PHIC4R,PHIC5R,PHIC6R,PHICLR,
     5               YCMP(6),ZCMP(6),PHICM(6)
      DIMENSION YCIP(2)
      EQUIVALENCE (YCIP(1),YC1P)
      COMMON /RUFNES/ DELG,DGMAX,NEND,IRUF
      DIMENSION DUM(18)
      DATA NBS/10/
      NBT = NBCRD+1
      IF(NBT.LT.1.OR.NBT.GT.NBS+1) GO TO 98
      GO TO (500,501,502,503,504,505,506,507,508,509,510),NBT
      GO TO 98
  500 IF(NCARD.NE.500) GO TO 98
      DO 10 I=1,18
   10 GHED(I) = DUM(I)
      GO TO 99
  501 IF(NCARD.NE.501) GO TO 98
      IF(NZTAB.LT.1) NZTAB=1
      I = 1
      GO TO 20
  502 IF(NCARD.NE.502) GO TO 98
      IF(NZTAB.LT.2) NZTAB = 2
      I = 2
      GO TO 20
  503 IF(NCARD.NE.503) GO TO 98
      IF(NZTAB.LT.3) NZTAB = 3
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      I = 3                                                   BLK50500
      GO TO 20                                                BLK50510
 504 IF(NCARD.NE.504) GO TO 98                                BLK50520
      IF(NZTAB.LT.4) NZTAB = 4                                BLK50530
      I = 4                                                   BLK50540
      GO TO 20                                                BLK50550
 505 IF(NCARD.NE.505) GO TO 98                                BLK50560
      NZTAB = 5                                               BLK50570
      I = 5                                                   BLK50580
  20 NPAGE(15) = 1                                            BLK50590
      XB(I)     = DUM(1)                                      BLK50600
      XE(I)     = DUM(2)                                      BLK50610
      XINCR(I) = DUM(3)                                       BLK50620
      YB(I)     = DUM(4)                                      BLK50630
      YE(I)     = DUM(5)                                      BLK50640
      YINCR(I) = DUM(6)                                       BLK50650
      NBX(I)    = DUM(7)                                      BLK50660
      NBY(I)    = DUM(8)                                      BLK50670
      NZ5T      = DUM(9)                                      BLK50680
      NNBX = NBX(I)                                           BLK50690
      NNBY = NBY(I)                                           BLK50700
      IF(NZ5T.EQ.1) GO TO 21                                  BLK50710
      NNX = (XE(I)-XB(I))/XINCR(I)+1                          BLK50720
      NNY = (YE(I)-YB(I))/YINCR(I)+1                          BLK50730
      NX(I) = NNX                                             BLK50740
      NY(I) = NNY                                             BLK50750
      CALL TEREAD(I,NNBX,NNBY,NNX,NNY,NZ5T,NERR)              BLK50760
      IF(NERR.NE.0) GO TO 98                                  BLK50770
      GO TO 99                                                BLK50780
  21 NNX = DUM(3)                                             BLK50790
      NNY = DUM(6)                                            BLK50800
      NX(I) = NNX                                             BLK50810
      NY(I) = NNY                                             BLK50820
      NZ5 = 1                                                 BLK50830
      CALL TEREAD(I,NNBX,NNBY,NNX,NNY,NZ5T,NERR)              BLK50840
      IF(NERR.NE.0) GO TO 98                                  BLK50850
      GO TO 99                                                BLK50860
 506 IF(NCARD.NE.506) GO TO 98                                BLK50870
      DO 30 J=1,5                                             BLK50880
  30 AMUG(J) = DUM(J)                                         BLK50890
      GO TO 99                                                BLK50900
 507 IF(NCARD.NE.507) GO TO 98                                BLK50910
      YC1P = DUM(1)                                           BLK50920
      YC2P = DUM(2)                                           BLK50930
      YC3P = DUM(3)                                           BLK50940
      YC4P = DUM(4)                                           BLK50950
      YC5P = DUM(5)                                           BLK50960
      YC6P = DUM(6)                                           BLK50970
      AMUC = DUM(7)                                           BLK50980
      GO TO 99                                                BLK50990
 508 IF(NCARD.NE.508) GO TO 98                                BLK51000
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      ZC2P = DUM(1)                                                     BLK51010
      ZC3P = DUM(2)                                                     BLK51020
      ZC4P = DUM(3)                                                     BLK51030
      ZC5P = DUM(4)                                                     BLK51040
      ZC6P = DUM(5)                                                     BLK51050
      GO TO 99                                                          BLK51060
  509 IF(NCARD.NE.509) GO TO 98                                         BLK51070
      PHIC1 = DUM(1)                                                    BLK51080
      PHIC2 = DUM(2)                                                    BLK51090
      PHIC3 = DUM(3)                                                    BLK51100
      PHIC4 = DUM(4)                                                    BLK51110
      PHIC5 = DUM(5)                                                    BLK51120
      PHIC6 = DUM(6)                                                    BLK51130
      GO TO 99                                                          BLK51140
  510 IF(NCARD.NE.510) GO TO 98                                         BLK51150
      DELG = DUM(1)                                                     BLK51160
      NEND = IFIX(DUM(2))                                               BLK51170
      IRUF = 1                                                          BLK51180
      NPAGE(8) = 1                                                      BLK51190
      DGMAX = (NEND-1)*DELG                                             BLK51200
      GO TO 99                                                          BLK51210
   98 NERR = 1                                                          BLK51220
   99 RETURN                                                            BLK51230
      END                                                               BLK51240
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      SUBROUTINE BLK06(NBLK,NBCRD,NSEQ,NCARD,DUM,NERR)                  BLK60010
C           HVOSM-VD2 VERSION -                                         BLK60020
C           REVISED OCTOBER 1975   CALSPAN CORPORATION                  BLK60030
      COMMON/HEAD/ VHED(20),CHED(20),GHED(20),SHED(20),THED(20),        BLK60040
     1             NPAGE(20)                                            BLK60050
      COMMON/INPT/PHIO,THETAO,PSIO,PO,QO,RO,XCOP,YCOP,ZCOP,UO,VO,WO,    BLK60060
     1            A,B,DEL10,DEL20,DEL30,PHIRO,DEL10D,DEL20D,DEL30D,     BLK60070
     2            PHIROD,TF,TR,ZF,ZR,RHO,AKRS,XMUR,                     BLK60080
     3            XMS,XMUF,XIX,XIY,XIZ,XIXZ,CF,AKF,XLAMF,OMEGF,CFP,EPSF,BLK60090
     4            RF,CR,AKR,XLAMR,OMEGR,CRP,EPSR,RR,TS,THMAX,DTCOMP,TO, BLK60100
     5            T1,DTCMP1,DTPRNT,MODE,EBAR,EM,AAA,HMAX,HMIN,BET,G,    BLK60110
     6            HED(36),DADE(3),XIR,X1,Y1,Z1,X2,Y2,Z2,PHIC(50),DELB,  BLK60120
     7            DELE,DDEL,NDEL,PSIF(50),TQF(50),TQR(50),TB,TE,TINCR,  BLK60130
     8            NZTAB,NZ5,XBDRY(4,5),PSBDRY(4,5),YBDRY(2,5),NBX(5),   BLK60140
     9            NBY(5),NTBL1,NTBL2,NTBL3,ZGP(21,21,5)                 BLK60150
      COMMON/INPT/XB(5),XE(5),XINCR(5),NX(5),YB(5),YE(5),YINCR(5),NY(5),BLK60160
     1          XXZGP5(21),YYZGP5(21),AMUG(5),PSBDRO(4,5),UVWMIN,PQRMIN BLK60170
      COMMON/INPT1/YC1P,YC2P,ZC2P,DELTC,PHIC1,PHIC2,AMUC,XIPS,          BLK60180
     1             CPSP,OMGPS,AKPS,EPSPS,XPS,RWHJB,RWHJE,DRWHJ,INDCRB,  BLK60190
     2             PSIFIO,PSIFDO                                        BLK60200
      DIMENSION YCIP(2)                                                 BLK60210
      EQUIVALENCE (YCIP(1),YC1P)                                        BLK60220
      COMMON/INPT5/ IBTYP(2),AK1,AK2,PONE,PTWO,PZERO(2),GN(16,2),ZETAB, BLK60230
     1              CONE,CTWO,CTHREE,TAUA,TAUO(4),TLF(51),TTAU(51),     BLK60240
     2              TRPME(12),TWOT(12),TCT(12),TT(101),TPC(101),TTR(101)BLK60250
     3             ,TTS(101),BTLF,ETLF,DTLF,NTLF,BRPM,ERPM,NRPM,        BLK60260
     4              BTT,ETT,DTT,NTT1,NTT2,NTT3,NTTS,XINPT5(9)           BLK60270
      COMMON /INSUS/ XIF,RHOF,TSF,PHIFO,PHIFOD,DEL40,DEL40D,ISUS,       BLK60280
     1               AKDS,AKDS1,AKDS2,AKDS3,PHIRC(50),DTHF(50),DTHR(50),BLK60290
     2               NCAMF,NCAMR,NDTHF,NDTHR                            BLK60300
      DIMENSION DUM(18)                                                 BLK60310
      DATA NBS/4/                                                       BLK60320
      NBT = NBCRD+1                                                     BLK60330
      IF(NBT.LT.1.OR.NBT.GT.NBS+1) GO TO 98                             BLK60340
      GO TO(600,601,602,603,604),NBT                                    BLK60350
      GO TO 98                                                          BLK60360
  600 IF(NCARD.NE.600) GO TO 98                                         BLK60370
      DO 10 I=1,18                                                      BLK60380
   10 SHED(I) = DUM(I)                                                  BLK60390
      GO TO 99                                                          BLK60400
  601 IF(NCARD.NE.601) GO TO 98                                         BLK60410
      PHIO   = DUM(1)                                                   BLK60420
      THETAO = DUM(2)                                                   BLK60430
      PSIO   = DUM(3)                                                   BLK60440
      PO     = DUM(4)                                                   BLK60450
      QO     = DUM(5)                                                   BLK60460
      RO = DUM(6)                                                       BLK60470
      PSIFIO = DUM(7)                                                   BLK60480
      PSIFDO = DUM(8)                                                   BLK60490
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      GO TO 99
  602 IF(NCARD.NE.602) GO TO 98
      XCOP = DUM(1)
      YCOP = DUM(2)
      ZCOP = DUM(3)
      UO   = DUM(4)
      VO   = DUM(5)
      WO   = DUM(6)
      GO TO 99
  603 IF(NCARD.NE.603) GO TO 98
      DEL10  = DUM(1)
      DEL20 = DUM(2)
      IF(ISUS.EQ.2) PHIF0 = DUM(2)
      DEL30  = DUM(3)
      PHIR0 = DUM(4)
      IF(ISUS.EQ.1) DEL40 = DUM(4)
      DEL10D = DUM(5)
      DEL20D = DUM(6)
      IF(ISUS.EQ.2) PHIF0D = DUM(6)
      DEL30D = DUM(7)
      PHIR0D = DUM(8)
      IF(ISUS.EQ.1) DEL40D = DUM(8)
      GO TO 99
  604 IF(NCARD.NE.604) GO TO 98
      TAUA = DUM(1)
      TAUO(1) = DUM(2)
      TAUO(2) = DUM(3)
      TAUO(3) = DUM(4)
      TAUO(4) = DUM(5)
      GO TO 99
   98 NERR = 1
   99 RETURN
      END
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      SUBROUTINE CLEAR(A,B)
C          CLEARS (SETS TO ZERO) A BLOCK OF STORAGE IDENTIFIED BY THE
C           ADDRESSES OF THE TWO ARGUMENTS.
C
C          CALL CLEAR(P,Q)
C          WILL CAUSE ALL BYTES TO BE SET TO ZERO FROM ADDRESS
C          P THROUGH THE FULL-WORD AT ADDRESS Q
C
      DIMENSION A(1),B(1)
      B(1) = 1.0
      I=0
   10 IF(B(1).EQ.0.0)  RETURN
      I=I+1
      A(I) = 0.0
      GO TO 10
      END
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      SUBROUTINE CNSTNT                                                 CNST0010
C           HVOSM-VD2 VERSION                                           CNST0020
C           REVISED OCTOBER 1975  CALSPAN CORPORATION                   CNST0030
      COMMON/HEAD/ VHED(20),CHED(20),GHED(20),SHED(20),THED(20),        CNST0040
     1          NPAGE(20)                                               CNST0050
      COMMON/INPT/PHIO,THETAO,PSIO,PO,QO,RO,XCOP,YCOP,ZCOP,UO,VO,WO,    CNST0060
     1          A,B,DEL10,DEL20,DEL30,PHIRO,DEL10D,DEL20D,DEL30D,       CNST0070
     2          PHIROD,TF,TR,ZF,ZR,RHO,AKRS,XMUR,                       CNST0080
     3          XMS,XMUF,XIX,XIY,XIZ,XIXZ,CF,AKF,XLAMF,OMEGF,CFP,EPSF,CNST0090
     4          RF,CR,AKR,XLAMR,OMEGR,CRP,EPSR,RR,TS,THMAX,DTCOMP,TO,   CNST0100
     5          T1,DTCMP1,DTPRNT,MODE,EBAR,EM,AAA,HMAX,HMIN,BET,G,      CNST0110
     6          HED(36),DADE(3),XIR,X1,Y1,Z1,X2,Y2,Z2,PHIC(50),DELB,    CNST0120
     7          DELE,DDEL,NDEL,PSIF(50),TQF(50),TQR(50),TB,TE,TINCR,    CNST0130
     8          NZTAB,NZ5,XBDRY(4,5),PSBDRY(4,5),YBDRY(2,5),NBX(5),     CNST0140
     9          NBY(5),NTBL1,NTBL2,NTBL3,ZGP(21,21,5)                   CNST0150
      COMMON/INPT/XB(5),XE(5),XINCR(5),NX(5),YB(5),YE(5),YINCR(5),NY(5),CNST0160
     1       XXZGP5(21),YYZGP5(21),AMUG(5),PSBDRC(4,5),UVWMIN,PQRMIN    CNST0170
      COMMON/INPT1/YC1P,YC2P,ZC2P,DELTC,PHIC1,PHIC2,AMUC,XIPS,          CNST0180
     1          CPSP,OMGPS,AKPS,EPSPS,XPS,RWHJB,RWHJE,DRWHJ,INDCRB,     CNST0190
     2          PSIF10,PSIFD0                                           CNST0200
      DIMENSION YC1P(2)                                                 CNST0210
      EQUIVALENCE (YCIP(1),YC1P)                                        CNST0220
      COMMON /INTG/NEQ,T,DT,VAR(50),DER(50)                             CNST0230
      EQUIVALENCE (U,VAR(1)),(V,VAR(2)),(W,VAR(3)),(P,VAR(4)),(Q,VAR(5))CNST0240
     1       ,(R,VAR(6)),(DEL1,VAR(7)),(DEL1D,VAR(8)),(DEL2,VAR(9)),CNST0250
     2          (DEL2D,VAR(10)),(DEL3,VAR(11)),(DEL3D,VAR(12)),         CNST0260
     3          (PHIR,VAR(13)),(PHIRD,VAR(14)),(THETTP,VAR(15)),        CNST0270
     4          (PHITP,VAR(16)),(PSITP,VAR(17)),(XCP,VAR(18)),          CNST0280
     5          (YCP,VAR(19)),(ZCP,VAR(20)),(PSIFI,VAR(21)),            CNST0290
     6          (PSIFID,VAR(22))                                        CNST0300
      EQUIVALENCE (DU,DER(1)),(DV,DER(2)),(DW,DER(3)),(DP,DER(4)),      CNST0310
     1          (DQ,DER(5)),(DR,DER(6)),(DDEL1,DER(7)),(DDEL1D,DER(8))CNST0320
     2       ,(DDEL2,DER(9)),(DDEL2D,DER(10)),(DDEL3,DER(11)),          CNST0330
     3          (DDEL3D,DER(12)),(DPHIR,DER(13)),(DPHIRD,DER(14)),      CNST0340
     4          (DTHTTP,DER(15)),(DPHITP,DER(16)),(DPSITP,DER(17)),     CNST0350
     5          (DXCP,DER(18)),(DYCP,DER(19)),(DZCP,DER(20)),           CNST0360
     6          (DPSIFI,DER(21)),(DDPSFI,DER(22))                       CNST0370
      EQUIVALENCE (VAR(9),PHIF),(VAR(10),PHIFD),(DER(9),DPHIF),         CNST0380
     1          (DER(10),DPHIFD)                                        CNST0390
      EQUIVALENCE (VAR(13),DEL4),(VAR(14),DEL4D),(DER(13),DDEL4),       CNST0400
     1          (DER(14),DDEL4D)                                        CNST0410
      COMMON /COMP/SUMM,THETN,PHIN,PSIN,PI,RAD,GAM1,GAM2,GAM3,GAM4,GAM5,CNST0420
     1          GAM6,GAM7,GAM8,GAM9,THETT,PHIT,PSIT,ZRO,TRO2,           CNST0430
     2          TFO2,TIZ,RHO2,RHOMUR,AMUF,BMUR,ZPR,TM4,RHMR2,AO2APB,    CNST0440
     3          BO2APB,RFTF,TSO2,RRTS,BROMUR,XMUFO2,AXMFO2,XMTFO4,      CNST0450
     4          XIZR,RTR,RHMR2I,XIXP,XIZP,XIXZP,XIYZP,D1PD2,D1MD2,      CNST0460
     5          ZRD3,ZRD3R,ZFD3R,ZFD12,TIZ2,TG61,DD1P2,DD1M2,RPR,PHRPCNST0470
     6         ,TAN1P,SPHTP,CPHTP,SECTP,SFXS,SFYS,SFZS,SNPS,SNTS,       CNST0480
     7          SNPSS,TPR,CAY,CBY,CGY,CAX,CBX,CGX,SFYU,SFXU,SFYUF,      CNST0490
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8             SFYUR,SFZU,COSTH,SINTH,COSPS,SINPS,COSPH,SINPH,ANG1,  CNST0500
9             ANG2,CPHI,SPHI,CPSI,SPSI,P1,P7,P3,P4,P5,P6,TX,TY,TZ   CNST0510
 COMMON /COMP/TRH,DISTX,DISTY,DISTD,DISTS,D21,ZETA4,ZETA4D,ZETA3,   CNST0520
1             ZETA3D,SFZ1,SNPU,SNTU,HCGH1,HCGH2,HCGH3,HCGH4,TERM1,  CNST0530
2             TERM2,SNPSU,SNPR,HCBH1,HCBH2,HCBH3,HCBH4,HCAH1,HCAH2,CNST0540
3             HCAH3,HCAH4,UQ,WP,UR,QR,VP,PR,P2,Q2,R2,VR,WQ,PQ,PHIR2CNST0550
4            ,PHIRD2,RPHRD,GCTH,GSTH,GCTSP,GCTCP,XXX,YYY,IX,IY,XX1,CNST0560
5             XX2,YY1,YY2,THG1,THG2,PHG1,PHG2,ZZ1,ZZ2,LLL           CNST0570
 DIMENSION HCAH(4),HCBH(4),HCGH(4)                                  CNST0580
 EQUIVALENCE (HCAH(1),HCAH1),(HCBH(1),HCBH1),(HCGH(1),HCGH1)        CNST0590
 COMMON /COMPN/ FRSP(4),FRCP(4),ICBHIT,JCBHIT,                      CNST0600
1               DPSIN1,TANPC1,TANPC2,PHIC1R,PHIC2R,AMUCMP,PHI1D,    CNST0610
2               PHI2D,LCB1(4),LCB2(4),IHIT,AJMTX(3,3),BMTX(3,3),    CNST0620
3               SFRX(4),SFRY(4),SFRZ(4),T1PSI,T2PSI,XMUGI(4)        CNST0630
 LOGICAL LCB1,LCB2                                                  CNST0640
 COMMON /TIRIN/ AKT(4),SIGT(4),XLAMT(4),A0(4),A1(4),A2(4),A3(4),    CNST0650
1               A4(4),OMEGT(4),AMU(4),RW(4),FJP(35,4),A234(4),      CNST0660
2               A12(4),OMT2A2(4),OMT2M1(4),A23(4),ITIS(4)           CNST0670
C  COMMON/EINDEX/ FOR EULER ANGLE INDEXING,MAIN,CNSTNT,DAUX,TMCNST  CNST0680
 COMMON/EINDEX/ TWOPI,PIO2,PIO4,XINDN,XINDL,THETTL,PHITL,PSITL,     CNST0690
1               COSTHN,SINTHN,COSPSN,SINPSN,COSPHN,SINPHN,CTHETP,   CNST0700
2               STHETP,CPSTP,SPSTP,BNMTX(3,3), CNMTX(3,3),ENDEIN    CNST0710
 COMMON /INPT4/ FIDJ(2),FIWJ(2),ARBR(2),NXUGMU,NXFRCP,XXUGMU(6),    CNST0720
A               XXFRCP(6),XMUMAT(6,6,4),XMXPMT(6,6,4),              CNST0730
B               XMXSMT(6,6,4),SLIPMT(6,6,4),CT(4),XMUM(4),          CNST0740
C               XMUXP(4),XMUXS(4),RRMC(4),RRM(4),COMEN4             CNST0750
 EQUIVALENCE (FIDJ(1),FIDJF),(FIDJ(2),FIDJR),(FIWJ(1),FIWJF)        CNST0760
 EQUIVALENCE (FIWJ(2),FIWJR),(ARBR(1),ARBRF),(ARBR(2),ARBRR)        CNST0770
 COMMON /COMP4/FIDAR(2),FIDIW(2),FIDWR2(2),SPHICI(4),CPHICI(4),     CNST0780
1              TIHI(4),ARBRI(4), PSITEM(4),SLPFAC(4),DTSTEP,DTTEST,CNST0790
2        DTINT,TWOPIR,FRTEST(4),XMUI(4),FRCPMU(4),HRTERM,SLIP(4),   CNST0800
3              SLIPT(4),RHOS(4),EPSS(4),TERMP(4),TERMB(4),TERM(4),  CNST0810
4              EPSSFC,FSXFAC(4),FSYFAC(4),FSZFAC(4),FRXFAC(4),      CNST0820
5              FRYFAC(4),FRZFAC(4),FCXFAC(4),FCYFAC(4),FCZFAC(4),   CNST0830
6              SFCDTR(4),SFSDTR(4),SFRCPR(4),SSLIP(4),FCAV(4),      CNST0840
7              FSAV(4),FRCPAV(4),SLIPAV(4),RPSSM(4),FCSLSM(4),      CNST0850
8           ARTQ6(4),TQFAC(4),ARFAC1(2),ARFAC2(2),RPSFA(2),RPSFB(2),CNST0860
9           RPSFC(2),RPSFD(2),HRPSFA(4),HRPSFB(4),HRPSFC(4),STEPD   CNST0870
 COMMON /COMP4/  XBRAK(16),IUVS(4),IUVB(4),IRPS,IDTCNT,ISTEP,ISTOP  CNST0880
 LOGICAL  IUVS,IUVB,IRPS                                            CNST0890
 COMMON/INPT5/ IBTYP(2),AK1,AK2,PONE,PTWO,PZERO(2),GN(16,2),ZETAB,  CNST0900
1              CONE,CTWO,CTHREE,TAUA,TAUO(4),TLF(51),TTAU(51),      CNST0910
2              TRPME(12),TWOT(12),TCT(12),TT(101),TPC(101),TTR(101)CNST0920
3             ,TTS(101),BTLF,ETLF,DTLF,NTLF,BRPM,ERPM,NRPM,         CNST0930
4              BTT,ETT,DTT,NTT1,NTT2,NTT3,NTTS,XINPT5(9)            CNST0940
 COMMON/COMP5/ TAU(4),TQD(2),TQB(4),PP(2),TLAMB(2),PC,RWDRIV,JDEND,CNST0950
1              NBTYP,ARFAC3(2),RPSFE(2),RHOSMX(3),SLIPMX(3),SLIPP,  CNST0960
2              RHOMAX,RHOSAV(4),SRHOS(4),UGW(4),ABSUGW(4),VECS,     CNST0970
3              DELTAE,PIO15R,COMEN5,TQE,RPME                        CNST0980
 COMMON /INTR/ NEQR,TIMR,DTR,VARR(12),DERR(12)                      CNST0990
 DIMENSION RPSI(4),DRPSI(4)                                         CNST1000
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      EQUIVALENCE(VARR(1),RPSI(1)),(DERR(1),DRPSI(1))
      COMMON /INSUS/ XIF,RHOF,TSF,PHIFO,PHIFOD,DEL40,DEL40D,ISUS,
     1               AKDS,AKDS1,AKDS2,AKDS3,PHIRC(50),DTHF(50),DTHR(50),
     2               NCAMF,NCAMR,NDTHF,NDTHR
      COMMON /SUSCMP/ XMURO2,BXMRO2,XMTRO4,ZFO,TSFO2,RHOF2,RHFMUF,
     1                RHF2MF,RF2MF1,RTF,RRTR,D3PD4,D3MD4,D43,DD3P4,
     2                DD3M4,ZFD1RF,ZRD34,RFPF,RPF2M,WFMF,PHFP,PHIF2,
     3                PHIFD2,RPHFD,ZFD1,ZFD2,ZRD4,TPF,SLOPE3,SLOPE4,
     4                PHI3D,PHI4D,DTHF1,DTHF2,DTHR3,DTHR4,DTDD1,
     5                DTDD2,DTDD3,DTDD4,FJF(4),SNPF
      COMMON/NEWCRB/ YC3P,YC4P,YC5P,YC6P,YCLP,
     1               ZC3P,ZC4P,ZC5P,ZC6P,ZCLP,
     2               PHIC3,PHIC4,PHIC5,PHIC6,NCRBSL,
     3               TANPC3,TANPC4,TANPC5,TANPC6,TANPCL,
     4               PHIC3R,PHIC4R,PHIC5R,PHIC6R,PHICLR,
     5               YCMP(6),ZCMP(6),PHICM(6)
      NPAGE(1) = 1
      NPAGE(2) = 1
      NPAGE(3) = 1
      NPAGE(11) = 1
      NPAGE(12) = 1
      NPAGE(13) = 1
      NPAGE(17) = 1
      PI = 3.14159265300
      TWOPI =  2.0*PI
      PIO2  =  0.5 * PI
      PIO4  =  0.25* PI
      TWOPIR = 1.0/TWOPI
      PIO15R = 15.0/PI
      RAD =   .01745329250D0
      DO 7 I=1,4
      A12(I) = A1(I)/A2(I)
      A23(I) = A2(I)*A3(I)/A1(I)
      A234(I) = A2(I)*A3(I)/A4(I)
      OMT2M1(I) = OMEGT(I)*A1(I)*A2(I)*(OMEGT(I)-1.0)
      OMT2A2(I) = (OMEGT(I)*A2(I)*A3(I)*(A4(I)-OMEGT(I)*A2(I)))
     1           /(A4(I)*(OMT2M1(I)-A0(I)))
    7 CONTINUE
      TRO2 = 0.5*TR
      TFO2 = 0.5*TF
      AMUF = A*XMUF
      BMUR = B*XMUR
      XMUFO2 = 0.5*XMUF
      AXMFO2 = A*XMUFO2
      XMTFO4 = XMUFO2*TFO2
      TM4 = 0.25*XMUF*TF
      GMSTMP = 0.5*XMS*G/(A+B)
      AO2APB = A*GMSTMP
      BO2APB = B*GMSTMP
      GAM1 = AMUF-BMUR
      SUMM = XMS+XMUF+XMUR
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```
      DEL1 = DEL10                                          CNST1520
      DEL1D = DEL10D                                        CNST1530
      DEL3 = DEL30                                          CNST1540
      DEL3D = DEL30D                                        CNST1550
      IF(ISUS.EQ.1) GO TO 10                                CNST1560
      ZRO = ZR+RHO                                          CNST1570
      TSO2 = 0.5*TS                                         CNST1580
      RHO2 = RHO*RHO                                        CNST1590
      RHOMUR = RHO*XMUR                                     CNST1600
      RHMR2 = RHO*RHOMUR                                    CNST1610
      RTR = RR/TS                                           CNST1620
      BROMUR = RHOMUR*B                                     CNST1630
      RHMR2I = RHMR2+XIR                                    CNST1640
      PHIR = PHIRO*RAD                                      CNST1650
      PHIRD = PHIROD*RAD                                    CNST1660
   10 IF(ISUS.NE.0) GO TO 20                                CNST1670
      ZPR = ZF+RHO                                          CNST1680
      RRTS = RR*TS                                          CNST1690
      TIZ = XMUF*(A*A+TFO2*TFO2)+BMUR                       CNST1700
      XIZR = XIZ+XIR                                        CNST1710
   20 IF(ISUS.EQ.2) GO TO 30                                CNST1720
      RFTF = RF/(TF*TF)                                     CNST1730
      DEL2 = DEL20                                          CNST1740
      DEL2D = DEL20D                                        CNST1750
   30 IF(ISUS.NE.2) GO TO 40                                CNST1760
      ZFO = ZF+RHOF                                         CNST1770
      TSFO2 = 0.5*TSF                                       CNST1780
      RHOF2 = RHOF*RHOF                                     CNST1790
      RHFMUF = RHOF*XMUF                                    CNST1800
      RHF2MF = RHOF*RHFMUF                                  CNST1810
      RF2MFI = RHF2MF+XIF                                   CNST1820
      RTF = RF/TSF                                          CNST1830
      PHIF = PHIFO*RAD                                      CNST1840
      PHIFD = PHIFOD*RAD                                    CNST1850
   40 IF(ISUS.NE.1) GO TO 50                                CNST1860
      RRTR = RR/(TR*TR)                                     CNST1870
      XMURO2 = 0.5*XMUR                                     CNST1880
      BXMRO2 = B*XMURO2                                     CNST1890
      XMTRO4 = XMURO2*TRO2                                  CNST1900
      DEL4 = DEL40                                          CNST1910
      DEL4D = DEL40D                                        CNST1920
   50 CONTINUE                                              CNST1930
      U = UO                                                CNST1940
      V = VO                                                CNST1950
      W = WO                                                CNST1960
      P = PO*RAD                                            CNST1970
      Q = QO*RAD                                            CNST1980
      R = RO*RAD                                            CNST1990
      THETTP = 0.0                                          CNST2000
      PHITP = 0.0                                           CNST2010
      PSITP = 0.0                                           CNST2020
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```
      THETN = THETAO*RAD
      PHIN = PHIO*RAD
      PSIN = PSIO*RAD
       XINDL IS PREVIOUS VALUE OF XINDN. XINDL INITIALLY ZERO GETS BNMTX
             XINDN.NE.0.0 FOR THETAO OR PHIO .NE.0.0, OR AFTER INDEXING
             THAT IS  THETN OR PHIN NOW .NE. 0.0
             USED IN MAIN PROGRAM AND IN SUBROUTINES CNSTNT,TMCNST
      IF( THETN.NE.0.0 .OR.  PHIN.NE. 0.0) XINDN = 10.0
      THETTL = THETN
      PHITL  = PHIN
      PSITL  = PSIN
      XCP = XCOP
      YCP = YCOP
      ZCP = ZCOP
      PHIC1R = PHIC1*RAD
      PHIC2R = PHIC2*RAD
      PHIC3R = PHIC3*RAD
      PHIC4R = PHIC4*RAD
      PHIC5R = PHIC5*RAD
      PHIC6R = PHIC6*RAD
      TANPC2 = TAN(PHIC2R)
      TANPC1 = TAN(PHIC1R)
      TANPC3 = TAN(PHIC3R)
      TANPC4 = TAN(PHIC4R)
      TANPC5 = TAN(PHIC5R)
      TANPC6 = TAN(PHIC6R)
      NCB = NCRBSL-1
      GO TO (72,73,74,75,76),NCB
   72 PHICLR = PHIC2R
      YCLP = YC2P
      ZCLP = ZC2P
      TANPCL = TANPC2
      YC3P = 1.0E+6
      ZC3P = ZC2P+SIGN(1.0,ZC2P)
      GO TO 71
   73 PHICLR = PHIC3R
      YCLP = YC3P
      ZCLP = ZC3P
      TANPCL = TANPC3
      YC4P = 1.0E+6
      ZC4P = ZC3P+SIGN(1.0,ZC3P)
      GO TO 71
   74 PHICLR = PHIC4R
      YCLP = YC4P
      ZCLP = ZC4P
      TANPCL = TANPC4
      YC5P = 1.0E+6
      ZC5P = ZC4P+SIGN(1.0,ZC4P)
      GO TO 71
   75 PHICLR = PHIC5R
      YCLP = YC5P
```

```
      ZCLP = ZC5P
      TANPCL = TANPC5
      YC6P = 1.0E+6
      ZC6P = ZC5P+SIGN(1.0,ZC5P)
      GO TO 71
   76 PHICLR = PHIC6R
      YCLP = YC6P
      ZCLP = ZC6P
      TANPCL = TANPC6
   71 CONTINUE
      PSIFI  = PSIFIO*RAD
      PSIFID = PSIFDO*RAD
      DO 9 I=1,5
      DO 9 J=1,4
    9 PSBDRY(J,I) = PSBDRO(J,I) * RAD
C      NOTE,FIDJ(1)=0 FOR REAR WHEEL DRIVE,  FIDJ(2)=0 FOR FRONT DRIVE
C             FOR WHEEL ROTATION EQUATIONS  FRONT J=1 , REAR J=2
      DO  12  J=1,2
      TBRAKB   =  0.25 * FIDJ(J)* ARBR(J) * ARBR(J)
      TBRAKA = FIWJ(J) + TBRAKB
      TBRAKD = 1.0 /(TBRAKA*TBRAKA - TBRAKB*TBRAKB)
      ARFAC1(J) = 6.0 * ARBR(J) *(TBRAKA-TBRAKB) * TBRAKD
      RPSFA(J) = TBRAKA * TBRAKD
      RPSFB(J) = TBRAKB * TBRAKD
      ARFAC2(J) = 6.0 * ARBR(J) / TBRAKA
      RPSFC(J) = 1.0 / TBRAKA
      RPSFD(J) = TBRAKB / TBRAKA
       TLAMB(J) = RPSFD(J)
      ARFAC3(J) = (RPSFA(J) - RPSFB(J)) * 12.0
      RPSFE(J) = 12.0 * RPSFC(J)
   12 CONTINUE
      DO 13 I=1,4
      J=1
      IF(I.GE.3) J=2
      ARBRI(I) = ARBR(J)
   13 CONTINUE
C        RWDRIV = 1.0 FOR REAR WHEEL DRIVE, =0.0 FOR FRONT WHEEL DRIVE
      RWDRIV = 1.0
      IF(FIDJ(2) .EQ.0.0) RWDRIV = 0.0
C     JDEND SIGNIFIES 'DRIVE' END OF VEHICLE, =1 FOR FRONT, =2 FOR REAR
      JDEND = 1
       IF(FIDJ(1).EQ.0.0) JDEND = 2
      DO 23 I=1,4
   23 TAU(I) = TAUO(I)
  130 DO 132 J=1,NTTS
  132 TT(J) = FLOAT(J-1)*DTT+BTT
      DO 134 J=1,NTLF
  134 TTAU(J) = FLOAT(J-1)*DTLF+BTLF
      DRPM = (ERPM-BRPM)/FLOAT(NRPM-1)
      DO 136 J=1,NRPM
  136 TRPME(J) = FLOAT(J-1)*DRPM+BRPM
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RETURN                                                    CNST3050
END                                                       CNST3060
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      SUBROUTINE CRBIMP(I)
C              HVOSM-VD2 VERSION
C              REVISED OCTOBER 1975   CALSPAN CORPORATION
      COMMON/INPT1/YC1P,YC2P,ZC2P,DELTC,PHIC1,PHIC2,AMUC,XIPS,
     1             CPSP,OMGPS,AKPS,EPSPS,XPS,RWHJB,RWHJE,DRWHJ,INDCRB,
     2             PSIFIO,PSIFDO
      DIMENSION YCIP(2)
      EQUIVALENCE (YCIP(1),YC1P)
      COMMON /INTG/NEQ,T,DT,VAR(50),DER(50)
      EQUIVALENCE (U,VAR(1)),(V,VAR(2)),(W,VAR(3)),(P,VAR(4)),(Q,VAR(5))
     1          ,(R,VAR(6)),(DEL1,VAR(7)),(DEL1D,VAR(8)),(DEL2,VAR(9)),
     2           (DEL2D,VAR(10)),(DEL3,VAR(11)),(DEL3D,VAR(12)),
     3           (PHIR,VAR(13)),(PHIRD,VAR(14)),(THETTP,VAR(15)),
     4           (PHITP,VAR(16)),(PSITP,VAR(17)),(XCP,VAR(18)),
     5           (YCP,VAR(19)),(ZCP,VAR(20)),(PSIFI,VAR(21)),
     6           (PSIFID,VAR(22))
      EQUIVALENCE (DU,DER(1)),(DV,DER(2)),(DW,DER(3)),(DP,DER(4)),
     1           (DQ,DER(5)),(DR,DER(6)),(DDEL1,DER(7)),(DDEL1D,DER(8))
     2          ,(DDEL2,DER(9)),(DDEL2D,DER(10)),(DDEL3,DER(11)),
     3           (DDEL3D,DER(12)),(DPHIR,DER(13)),(DPHIRD,DER(14)),
     4           (DTHTTP,DER(15)),(DPHITP,DER(16)),(DPSITP,DER(17)),
     5           (DXCP,DER(18)),(DYCP,DER(19)),(DZCP,DER(20)),
     6           (DPSIFI,DER(21)),(DDPSFI,DER(22))
      EQUIVALENCE (VAR(9),PHIF),(VAR(10),PHIFD),(DER(9),DPHIF),
     1           (DER(10),DPHIFD)
      EQUIVALENCE (VAR(13),DEL4),(VAR(14),DEL4D),(DER(13),DDEL4),
     1           (DER(14),DDEL4D)
      COMMON /DIMV/X1P,X2P,X3P,X4P,Y1P,Y2P,Y3P,Y4P,Z1P,Z2P,Z3P,Z4P,PHI1,
     1             PHI2,PHI3,PHI4,PSI1,PSI2,PSI3,PSI4,CAYW(4),CBYW(4),
     2             CGYW(4),ZPGI(4),THGI(4),PHGI(4),CPG(4),SPG(4),CTG(4),
     3             STG(4),CAGZ(4),CBGZ(4),CGGZ(4),D1(4),D2(4),D3(4),
     4             XLM1(4),XLM2(4),XLM3(4),AMTX(3,3),CMTX(3,4),XGPP(4),
     5             YGPP(4),ZGPP(4),DMATX(10,11),DELTA(4),CAR(4),CBR(4),
     6             CGR(4),FR(4),HI(4),FC(4),TI(4),AX(4),BX(4),CX(4),
     7             CTXG(4),UG(4),STXG(4),AY(4),BY(4),CY(4),CPYG(4),
     8             SPYG(4),VG(4),PSIIP(4),PHICI(4),CAC(4),CBC(4),CGC(4),
     9             FCXU(4),FCYU(4),FCZU(4),FS(4),CAXW(4),CBXW(4),CGXW(4)
      COMMON /DIMV/AS(4),BS(4),CS(4),CAS(4),CBS(4),CGS(4),BETP(4),
     1             BETBR(4),FSXU(4),FSYU(4),FSZU(4),FRXU(4),FRYU(4),
     2             FRZU(4),FXU(4),FYU(4),FZU(4),SI(4),F1FI(2),F1RI(2),
     3             F2FI(2),F2RI(2),CAH(4),CBH(4),CGH(4)
      DIMENSION XP(4),YP(4),ZP(4),PHII(4),PSII(4)
      EQUIVALENCE (XP(1),X1P),(YP(1),Y1P),(ZP(1),Z1P),(PHII(1),PHI1),
     1           (PSII(1),PSI1)
      COMMON /COMP/SUMM,THETN,PHIN,PSIN,PI,RAD,GAM1,GAM2,GAM3,GAM4,GAM5,
     1           GAM6,GAM7,GAM8,GAM9,THETT,PHIT,PSIT,ZRO,TRO2,
     2             TFO2,TIZ,RHO2,RHOMUR,AMUF,BMUR,ZPR,TM4,RHMR2,AO2APB,
     3             BO2APB,RFTF,TSO2,RRTS,BROMUR,XMUFO2,AXMFO2,XMTFO4,
     4             XIZR,RTR,RHMR2I,XIXP,XIZP,XIXZP,XIYZP,D1PD2,D1MD2,
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     5            ZRD3,ZRD3R,ZFD3R,ZFD12,TIZ2,TG61,DD1P2,DD1M2,RPR,PHRP
     6           ,TANTP,SPHTP,CPHTP,SECTP,SFXS,SFYS,SFZS,SNPS,SNTS,
     7            SNPSS,TPR,CAY,CBY,CGY,CAX,CBX,CGX,SFYU,SFXU,SFYUF,
     8            SFYUR,SFZU,COSTH,SINTH,COSPS,SINPS,COSPH,SINPH,ANG1,
     9            ANG2,CPHI,SPHI,CPSI,SPSI,P1,P7,P3,P4,P5,P6,TX,TY,TZ
      COMMON /COMP/TRH,DISTX,DISTY,DISTD,DISTS,D21,ZETA4,ZETA4D,ZETA3,
     1            ZETA3D,SFZ1,SNPU,SNTU,HCGH1,HCGH2,HCGH3,HCGH4,TERM1,
     2            TERM2,SNPSU,SNPR,HCBH1,HCBH2,HCBH3,HCBH4,HCAH1,HCAH2,
     3            HCAH3,HCAH4,UQ,WP,UR,QR,VP,PR,P2,Q2,R2,VR,WQ,PQ,PHIR2
     4           ,PHIRD2,RPHRD,GCTH,GSTH,GCTSP,GCTCP,XXX,YYY,IX,IY,XX1,
     5            XX2,YY1,YY2,THG1,THG2,PHG1,PHG2,ZZ1,ZZ2,LLL
      DIMENSION HCAH(4),HCBH(4),HCGH(4)
      EQUIVALENCE (HCAH(1),HCAH1),(HCBH(1),HCBH1),(HCGH(1),HCGH1)
      COMMON /COMPN/ FRSP(4),FRCP(4),ICBHIT,JCBHIT,
     1              DPSINT,TANPC1,TANPC2,PHIC1R,PHIC2R,AMUCMP,PHI1D,
     2              PHI2D,LCB1(4),LCB2(4),IHIT,AJMTX(3,3),BMTX(3,3),
     3              SFRX(4),SFRY(4),SFRZ(4),T1PSI,T2PSI,XMUGI(4)
      LOGICAL LCB1,LCB2
      COMMON /TIRIN/ AKT(4),SIGT(4),XLAMT(4),A0(4),A1(4),A2(4),A3(4),
     1              A4(4),OMEGT(4),AMU(4),RW(4),FJP(35,4),A234(4),
     2              A12(4),OMT2A2(4),OMT2M1(4),A23(4),ITIR(4)
      COMMON/NEWCRB/ YC3P,YC4P,YC5P,YC6P,YCLP,
     1              ZC3P,ZC4P,ZC5P,ZC6P,ZCLP,
     2              PHIC3,PHIC4,PHIC5,PHIC6,NCRBSL,
     3              TANPC3,TANPC4,TANPC5,TANPC6,TANPCL,
     4              PHIC3R,PHIC4R,PHIC5R,PHIC6R,PHICLR,
     5              YCMP(6),ZCMP(6),PHICM(6)
      DIMENSION FJPP(35)
      DO 20 N=1,35
   20 FJPP(N) = FJP(N,I)
    1 SNPSI = SIN(PSII(I))
      CSPSI = COS(PSII(I))
      SNPHI = SIN(PHII(I))
      CSPHI = COS(PHII(I))
      SFRX(I) = 0.0
      SFRY(I) = 0.0
      SFRZ(I) = 0.0
      TTAJ21 = CSPHI * SNPSI
      TTAJ31 = SNPHI * SNPSI
      AJMTX(1,2) = -SNPSI
      AJMTX(2,2) = CSPHI * CSPSI
      AJMTX(3,2) = SNPHI * CSPSI
      XJ = -26.0*RAD
    2 DO 11  J=1,53
      THTJ = 4.0*XJ
      STJ = SIN(THTJ)
      CTJ = COS(THTJ)
      AJMTX(1,1) = CTJ*CSPSI
      AJMTX(2,1) = TTAJ21*CTJ + SNPHI*STJ
      AJMTX(3,1) = TTAJ31*CTJ - CSPHI*STJ
      AJMTX(1,3) = CSPHI*STJ
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      AJMTX(2,3) = TTAJ21*STJ - SNPHI*CTJ
      AJMTX(3,3) = TTAJ31*STJ + CSPHI*CTJ
C       AJMTX ANGLE SEQUENCE IS PHI,PSI,THJ
    3 DO 8  K=1,3
    4 DO 7  L=1,3
      BMTX(K,L) = 0.0
    5 DO 6  M=1,3
      BMTX(K,L) = BMTX(K,L)+AMTX(K,M)*AJMTX(M,L)
    6 CONTINUE
    7 CONTINUE
    8 CONTINUE
      HJ = -ZP(I)/BMTX(3,3)
      IF(HJ.LT.0.0.OR.HJ.GE.RW(I)) GO TO 800
      YJP = YP(I)+BMTX(2,3)*HJ
      IF(YJP.LT.YC1P) GO TO 203
  800 HJ = (-ZP(I)+(YP(I)-YC1P)*TANPC1)/(BMTX(3,3)-BMTX(2,3)*TANPC1)
      IF(HJ.LT.0.0.OR.HJ.GE.RW(I)) GO TO 805
      YJP = YP(I)+BMTX(2,3)*HJ
      ZJP = ZP(I)+BMTX(3,3)*HJ
      IF(YJP.GE.YC1P.AND.YJP.LE.YC2P.AND.(ABS(ZJP).LE.ABS(ZC2P)).AND.
     1  (SIGN(1.0,ZJP).EQ.SIGN(1.0,ZC2P))) GO TO 204
  805 HJ = (ZC2P-ZP(I)+(YP(I)-YC2P)*TANPC2)/(BMTX(3,3)-BMTX(2,3)*
     1      TANPC2)
      IF(HJ.LT.0.0.OR.HJ.GE.RW(I)) GO TO 810
      YJP = YP(I)+BMTX(2,3)*HJ
      ZJP = ZP(I)+BMTX(3,3)*HJ
      IF(YJP.GT.YC2P.AND.YJP.LE.YC3P.AND.(ABS(ZJP).LE.ABS(ZC3P)).AND.
     1  (SIGN(1.0,ZJP).EQ.SIGN(1.0,ZC3P))) GO TO 204
  810 IF(NCRBSL.EQ.2) GO TO 10
      HJ = (ZC3P-ZP(I)+(YP(I)-YC3P)*TANPC3)/(BMTX(3,3)-BMTX(2,3)*TANPC3)
      IF(HJ.LT.0.0.OR.HJ.GE.RW(I)) GO TO 815
      YJP = YP(I)+BMTX(2,3)*HJ
      ZJP = ZP(I)+BMTX(3,3)*HJ
      IF(YJP.GT.YC3P.AND.YJP.LE.YC4P.AND.(ABS(ZJP).LE.ABS(ZC4P)).AND.
     1  (SIGN(1.0,ZJP).EQ.SIGN(1.0,ZC4P))) GO TO 204
  815 IF(NCRBSL.EQ.3) GO TO 10
      HJ= (ZC4P-ZP(I)+(YP(I)-YC4P)*TANPC4)/(BMTX(3,3)-BMTX(2,3)*TANPC4)
      IF(HJ.LT.0.0.OR.HJ.GE.RW(I)) GO TO 820
      YJP = YP(I)+BMTX(2,3)*HJ
      ZJP = ZP(I)+BMTX(3,3)*HJ
      IF(YJP.GT.YC4P.AND.YJP.LE.YC5P.AND.(ABS(ZJP).LE.ABS(ZC5P)).AND.
     1  (SIGN(1.0,ZJP).EQ.SIGN(1.0,ZC5P))) GO TO 204
  820 IF(NCRBSL.EQ.4) GO TO 10
      HJ= (ZC5P-ZP(I)+(YP(I)-YC5P)*TANPC5)/(BMTX(3,3)-BMTX(2,3)*TANPC5)
      IF(HJ.LT.0.0.OR.HJ.GE.RW(I)) GO TO 825
      YJP = YP(I)+BMTX(2,3)*HJ
      ZJP = ZP(I)+BMTX(3,3)*HJ
      IF(YJP.GT.YC5P.AND.YJP.LE.YC6P.AND.(ABS(ZJP).LE.ABS(ZC6P)).AND.
     1  (SIGN(1.0,ZJP).EQ.SIGN(1.0,ZC6P))) GO TO 204
  825 IF(NCRBSL.EQ.5) GO TO 10
      HJ= (ZC6P-ZP(I)+(YP(I)-YC6P)*TANPC6)/(BMTX(3,3)-BMTX(2,3)*TANPC6)
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      IF(HJ.LT.0.0.OR.HJ.GE.RW(I)) GO TO 10                              CRBI1520
      YJP = YP(I)+BMTX(2,3)*HJ                                           CRBI1530
      IF(YJP.LT.YC6P) GO TO 10                                           CRBI1540
  203 ZJP = ZP(I)+BMTX(3,3)*HJ                                           CRBI1550
  204 XJP = XP(I)+BMTX(1,3)*HJ                                           CRBI1560
      CAJ = (XP(I)-XJP)/HJ                                               CRBI1570
      CBJ = (YP(I)-YJP)/HJ                                               CRBI1580
      CGJ = (ZP(I)-ZJP)/HJ                                               CRBI1590
      CALL INTRPL(FJPP,RWHJB,RWHJE,DRWHJ,RW(I)-HJ,FJ)                    CRBI1600
      SFRX(I) = SFRX(I)+FJ*CAJ                                           CRBI1610
      SFRY(I) = SFRY(I)+FJ*CBJ                                           CRBI1620
      SFRZ(I) = SFRZ(I)+FJ*CGJ                                           CRBI1630
   10 XJ = XJ+RAD                                                        CRBI1640
   11 CONTINUE                                                           CRBI1650
      FR(I) = SQRT(SFRX(I)**2+SFRY(I)**2+SFRZ(I)**2)                     CRBI1660
      IF(FR(I).NE.0.0)GO TO 110                                          CRBI1670
      CAR(I) = 0.0                                                       CRBI1680
      CBR(I) = 0.0                                                       CRBI1690
      CGR(I) = 0.0                                                       CRBI1700
      HI(I) = RW(I)                                                      CRBI1710
      RETURN                                                             CRBI1720
  110 CAR(I) = -SFRX(I)/FR(I)                                            CRBI1730
      CBR(I) = -SFRY(I)/FR(I)                                            CRBI1740
      CGR(I) = -SFRZ(I)/FR(I)                                            CRBI1750
      HI(I) = RW(I)-FR(I)/AKT(I)                                         CRBI1760
      IF(HI(I).GT.RW(I)-SIGT(I)) GO TO 111                               CRBI1770
      HI(I) = RW(I)-(FR(I)/AKT(I)+SIGT(I)*(XLAMT(I)-1.0))/XLAMT(I)       CRBI1780
  111 TYGP = YP(I)+HI(I)*CBR(I)                                          CRBI1790
      PHGI(I) = 0.0                                                      CRBI1800
      IF(TYGP.LE.YC1P)GO TO 12                                           CRBI1810
      IF(TYGP.GT.YC1P.AND.TYGP.LE.YC2P) GO TO 900                        CRBI1820
      GO TO 905                                                          CRBI1830
  900 PHGI(I) = PHIC1R                                                   CRBI1840
      GO TO 12                                                           CRBI1850
  905 IF(NCRBSL.EQ.2) GO TO 970                                          CRBI1860
      IF(TYGP.GT.YC2P.AND.TYGP.LE.YC3P) GO TO 910                        CRBI1870
      GO TO 915                                                          CRBI1880
  910 PHGI(I) = PHIC2R                                                   CRBI1890
      GO TO 12                                                           CRBI1900
  915 IF(NCRBSL.EQ.3) GO TO 970                                          CRBI1910
      IF(TYGP.GT.YC3P.AND.TYGP.LE.YC4P) GO TO 920                        CRBI1920
      GO TO 925                                                          CRBI1930
  920 PHGI(I) = PHIC3R                                                   CRBI1940
      GO TO 12                                                           CRBI1950
  925 IF(NCRBSL.EQ.4) GO TO 970                                          CRBI1960
      IF(TYGP.GT.YC4P.AND.TYGP.LE.YC5P) GO TO 930                        CRBI1970
      GO TO 935                                                          CRBI1980
  930 PHGI(I) = PHIC4R                                                   CRBI1990
      GO TO 12                                                           CRBI2000
  935 IF(NCRBSL.EQ.5) GO TO 970                                          CRBI2010
      IF(TYGP.GT.YC5P.AND.TYGP.LE.YC6P) GO TO 940                        CRBI2020
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      GO TO 970                                                          CRBI2030
  940 PHGI(I) = PHIC5R                                                   CRBI2040
      GO TO 12                                                           CRBI2050
  970 PHGI(I) = PHICLR                                                   CRBI2060
   12 TCI = CAR(I)*CBYW(I)-CBR(I)*CAYW(I)                                CRBI2070
      TAI = CBR(I)*CGYW(I)-CGR(I)*CBYW(I)                                CRBI2080
      TBI = CGR(I)*CAYW(I)-CAR(I)*CGYW(I)                                CRBI2090
      CPG(I) = COS(PHGI(I))                                              CRBI2100
      SPG(I) = SIN(PHGI(I))                                              CRBI2110
      TERM3 = TBI*SPG(I)                                                 CRBI2120
      TERM4 = TCI*CPG(I)                                                 CRBI2130
      DN1 = TAI * (TERM3 - TERM4)                                        CRBI2140
      DN2 = -TBI*TERM4 - (TAI**2 + TCI**2)*SPG(I)                        CRBI2150
      DN3 =  (TAI**2 + TBI**2)*CPG(I)  + TCI*TERM3                       CRBI2160
      TERM5 = SQRT(DN1**2 + DN2**2 + DN3**2)                             CRBI2170
      SPG(I) = (-DN2/TERM5)                                              CRBI2180
      PHGI(I) = ARSIN(SPG(I))                                            CRBI2190
      THGI(I) = ATAN (DN1/DN3)                                           CRBI2200
      CPG(I) = COS(PHGI(I))                                              CRBI2210
      TERM6 = SQRT(DN1**2 + DN3**2)                                      CRBI2220
      CTG(I) = DN3/TERM6                                                 CRBI2230
      STG(I) = DN1/TERM6                                                 CRBI2240
C     STORE XGPP(I),YGPP(I) AS WELL AS ZGPP(I) IN CRBIMP FOR PLOTTING    CRBI2250
      XGPP(I) = XP(I) + HI(I) * CAR(I)                                   CRBI2260
      YGPP(I) = TYGP                                                     CRBI2270
      ZGPP(I) = ZP(I)+HI(I)*CGR(I)                                       CRBI2280
      RETURN                                                             CRBI2290
      END                                                                CRBI2300
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      SUBROUTINE CTQB
C             HVOSM-VD2 VERSION
C             REVISED OCTOBER 1975   CALSPAN CORPORATION
      COMMON/INPT5/ IBTYP(2),AK1,AK2,PONE,PTWO,PZERO(2),GN(16,2),ZETAB,
     1              CONE,CTWO,CTHREE,TAUA,TAU0(4),TLF(51),TTAU(51),
     2              TRPME(12),TWOT(12),TCT(12),TT(101),TPC(101),TTR(101)
     3             ,TTS(101),BTLF,ETLF,DTLF,NTLF,BRPM,ERPM,NRPM,
     4              BTT,ETT,DTT,NTT1,NTT2,NTT3,NTTS,XINPT5(9)
      COMMON/COMP5/ TAU(4),TQD(2),TQB(4),PP(2),TLAMB(2),PC,RWDRIV,JDEND,
     1              NBTYP,ARFAC3(2),RPSFE(2),RHOSMX(3),SLIPMX(3),SLIPP,
     2              RHOMAX,RHOSAV(4),SRHOS(4),UGW(4),ABSUGW(4),VECS,
     3              DELTAE,PIO15R,COMEN5,TQE,RPME
C
C  THIS SUBROUTINE COMPUTES BRAKE TORQUES AT EACH WHEEL
C
       P1 = PONE
      P2 = PTWO
      PP(1) = PC
      PP(2) = PC
   10 IF((PC.GT.P1).AND.(PC.LE.P2)) PP(2)= P1 + AK1 * (PC - P1)
      IF( PC.GT.P2) PP(2)= P1 + AK1 * (P2-P1) + AK2 * (PC - P2)
C
C  JFR   FRONT WHEELS JFR=1; REAR WHEELS JFR=2
C
      DO 45 I=1,4
      JFR = 1
      IF(I.GT.2) JFR = 2
      NBTYP = IBTYP(JFR)
      PJ = PP(JFR)
      PJZ = PZERO(JFR)
      TQB(I) = 0.0
      IF((PJ-PJZ).LT.0.0) GO TO 45
      TEMP = TAU(I)
      DO 17 L=2,NTLF
       LL = L-1
   15  IF( TEMP.EQ.TTAU(LL)) GO TO 20
      IF((TEMP.GT.TTAU(LL)).AND.(TEMP.LE.TTAU(L))) GO TO 22
   17 CONTINUE
   18 PRINT 19
   19 FORMAT(1H0,3X,'LAST VALUE IN TABLE USED FOR FADE COEFF.(FLF)')
   20 FLF = TLF(LL)
      GO TO 23
C
C  PARI - FUNCTION SUBROUTINE TO DO LAGRANGIAN INTERPOLATION
C
   22 FLF = PARI(NTLF,LL,TEMP,TTAU,TLF)
   23 GO TO (24,30,33,44),NBTYP
   24 GGLF = GN(2,JFR) * GN(3,JFR) * FLF
      OMGGLF = 1.0 - GGLF
```

```
      GX =  (GN(4,JFR)*(1.0+GGLF )+ GN(5,JFR)*OMGGLF)/ OMGGLF**2         CTQB0500
      TQB(1) = (1.0/12.0)*(PJ-PJZ)*GN(1,JFR)*GGLF*GX                     CTQB0510
      GO TO 45                                                           CTQB0520
   30 GGLF = GN(2,JFR) * GN(3,JFR) * FLF                                 CTQB0530
      TQB(1) = ((PJ-PJZ)/6.0)*GN(1,JFR)*GN(4,JFR)*(GGLF/(1.0-GGLF))      CTQB0540
      GO TO 45                                                           CTQB0550
   33 GGLF = GN(8,JFR) * GN(12,JFR) * FLF                                CTQB0560
      OMGGL = (1.0 -GN(2,JFR) * GN(12,JFR) *FLF) * GN(9,JFR) *GN(10,JFR)CTQB0570
   35 TTTA=(GN(4,JFR)*(PJ-PJZ))/12.0                                     CTQB0580
      TTTB= GN(3,JFR)*FLF                                                CTQB0590
      TTTSZ = TTTB/SQRT(1.0 + TTTB**2)                                   CTQB0600
      TTTSZG = TTTSZ * GN(7,JFR)                                         CTQB0610
      TTTB = 1.0 + ((GN(6,JFR)+TTTSZG)/(GN(1,JFR)-GN(6,JFR)-TTTSZG))     CTQB0620
   40 TTTC=TTTSZG +(GN(11,JFR)*GGLF)/OMGGL                               CTQB0630
      TTTD=GN(1,JFR)*GGLF/OMGGL                                          CTQB0640
      TQB(I) =  TTTA * (TTTB*TTTC - TTTD)                                CTQB0650
      GO TO 45                                                           CTQB0660
   44 TQB(I) =((PJ-PJZ)/6.0)*GN(3,JFR)*GN(4,JFR)*GN(13,JFR) * FLF        CTQB0670
   45 CONTINUE                                                           CTQB0680
      RETURN                                                             CTQB0690
      END                                                                CTQB0700
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```
      SUBROUTINE CTQD
C              HVOSM-VD2 VERSION
C              REVISED OCTOBER 1975   CALSPAN CORPORATION
C
C     THIS SUBROUTINE COMPUTES DRIVE LINE TORQUE AT THE PROPELLER SHAFT AT
C     VEHICLE END J
C
C     J = 1 OR 2 DEPENDING ON WHETHER FRONT OR REAR WHEEL DRIVE
C     TWOT   -  TABLE OF ENGINE TORQUE WIDE OPEN THROTTLE
C     TCT    -  TABLE OF ENGINE TORQUE CLOSED THROTTLE
C     TRPME  -  TABLE OF ENGINE REVOLUTIONS
C     NTTS   -  NO. VALUES LISTED IN TABLE OF THROTTLE SETTINGS, MASTER CYL.
C               PRESSURE AND TRANSMISSION RATIO.
C     TTS    -  TABLE OF THROTTLE SETTINGS
C     TTR    -  TABLE OF TRANSMISSION RATIOS
C     TPC    -  TABLE OF MASTER CYLINDER PRESSURES
C     TT     -  TABLE OF TIME IN SECS. CORRES.TO TABULAR VALUES OF PC,TS,TR
C     TSEC   -  TIME IN SECS.
C
C     FIND TTTS,TTTR,PC FROM TABLES AT TIME TSEC
      COMMON /INTG/NEQ,T,DT,VAR(50),DER(50)
      EQUIVALENCE (U,VAR(1)),(V,VAR(2)),(W,VAR(3)),(P,VAR(4)),(Q,VAR(5))
     1            ,(R,VAR(6)),(DEL1,VAR(7)),(DEL1D,VAR(8)),(DEL2,VAR(9)),
     2             (DEL2D,VAR(10)),(DEL3,VAR(11)),(DEL3D,VAR(12)),
     3             (PHIR,VAR(13)),(PHIRD,VAR(14)),(THETTP,VAR(15)),
     4             (PHITP,VAR(16)),(PSITP,VAR(17)),(XCP,VAR(18)),
     5             (YCP,VAR(19)),(ZCP,VAR(20)),(PSIFI,VAR(21)),
     6             (PSIFID,VAR(22))
      EQUIVALENCE (DU,DER(1)),(DV,DER(2)),(DW,DER(3)),(DP,DER(4)),
     1             (DQ,DER(5)),(DR,DER(6)),(DDEL1,DER(7)),(DDEL1D,DER(8))
     2            ,(DDEL2,DER(9)),(DDEL2D,DER(10)),(DDEL3,DER(11)),
     3             (DDEL3D,DER(12)),(DPHIR,DER(13)),(DPHIRD,DER(14)),
     4             (DTHTTP,DER(15)),(DPHITP,DER(16)),(DPSITP,DER(17)),
     5             (DXCP,DER(18)),(DYCP,DER(19)),(DZCP,DER(20)),
     6             (DPSIFI,DER(21)),(DDPSFI,DER(22))
      EQUIVALENCE (VAR(9),PHIF),(VAR(10),PHIFD),(DER(9),DPHIF),
     1             (DER(10),DPHIFD)
      EQUIVALENCE (VAR(13),DEL4),(VAR(14),DEL4D),(DER(13),DDEL4),
     1             (DER(14),DDEL4D)
      COMMON /INPT4/ FIDJ(2),FIWJ(2),ARBR(2),NXUGMU,NXFRCP,XXUGMU(6),
     A                XXFRCP(6),XMUMAT(6,6,4),XMXPMT(6,6,4),
     B                XMXSMT(6,6,4),SLIPMT(6,6,4),CT(4),XMUM(4),
     C                XMUXP(4),XMUXS(4),RRMC(4),RRM(4),COMEN4
      EQUIVALENCE (FIDJ(1),FIDJF),(FIDJ(2),FIDJR),(FIWJ(1),FIWJF)
      EQUIVALENCE (FIWJ(2),FIWJR),(ARBR(1),ARBRF),(ARBR(2),ARBRR)
      COMMON/INPT5/ IBTYP(2),AK1,AK2,PONE,PTWO,PZERO(2),GN(16,2),ZETAB,
     1               CONE,CTWO,CTHREE,TAUA,TAUO(4),TLF(51),TTAU(51),
     2               TRPME(12),TWOT(12),TCT(12),TT(101),TPC(101),TTR(101)
     3              ,TTS(101),BTLF,ETLF,DTLF,NTLF,BRPM,ERPM,NRPM,
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     4            BTT,ETT,DTT,NTT1,NTT2,NTT3,NTTS,XINPT5(9)                  CTQD0500
      COMMON/COMP5/ TAU(4),TQD(2),TQB(4),PP(2),TLAMB(2),PC,RWDRIV,JDEND,CTQD0510
     1            NBTYP,ARFAC3(2),RPSFE(2),RHOSMX(3),SLIPMX(3),SLIPP,  CTQD0520
     2            RHOMAX,RHOSAV(4),SRHOS(4),UGW(4),ABSUGW(4),VECS,     CTQD0530
     3            DELTAE,PIO15R,COMEN5,TQE,RPME                        CTQD0540
      COMMON /INTR/ NEQR,TIMR,DTR,VARR(12),DERR(12)                     CTQD0550
      DIMENSION RPSI(4),DRPSI(4)                                        CTQD0560
      EQUIVALENCE(VARR(1),RPSI(1)),(DERR(1),DRPSI(1))                   CTQD0570
      COMMON/DRIVTT/TPATH,DELPTH,TCTEST(6),ITESTT,ITCHNG,IPATHT,IDRIVE, CTQD0580
     1            IDRVER,IBUG                                          CTQD0590
C       IPATHT - STOP FOR DRIVER MODEL                                   CTQD0600
C       IDRIVE - NOT ZERO, SAMPLE TIME FOR DRIVER MODEL                  CTQD0610
C       ITCHNG - NOT ZERO, CHANGE DESIRED SPEED AND DISTANCE             CTQD0620
C       ITESTT,TCTEST(6) - INDEX AND INPUT TIMES FOR SPEED CHANGES       CTQD0630
      COMMON/DRIVI/NEN,EMDT,ES,DS,APDMAX,FKDO,FKPO,FKS10,FKS20,FKSKDO,  CTQD0640
     1           TESTBO,TSTS10,TSTS20,TSTR10,TSTR20,OMEGAO,TAUF,TIL,   CTQD0650
     2           TL,S(5,2),NTRAN,YTRANS(6),GEAR1,GEAR2,GEAR3,GEAR4,    CTQD0660
     3           VGR12,VGR23,VGR34,VGR43,VGR32,VGR21,                  CTQD0670
     4           TESTT(5),DESSI(5),DISTI(5),PSIFHO,XIMPOR(9),          CTQD0680
     5           BFP1,BFP2,DRIEND                                      CTQD0690
      COMMON/DRIVE/EN,FKD,FKP,FKS1,FKS2,FKSKID,TESTB,TESTS1,TESTS2,     CTQD0700
     1           TESTR1,TESTR2,THESKD,FBRK,APB,DSCES,                  CTQD0710
     2           TRKIN,TMT,DESS,DIST,DISTC,CONMPH,UT,UTMPH,            CTQD0720
     3           APD,DELTAX,DELTV,TJ,TTEM,TTPSIT,PSISKD,ST,STSO2,QAY,  CTQD0730
     4           AXP,AYP,DI,UP,XVP,YVP,SLOPE,SLOPER,PSIJ,XINT,X,Y,     CTQD0740
     5           TERMX,TERMY,TEMPOR,AE,EI,EWT,AREI(7),ARCAPE(7),ET,    CTQD0750
     6           PSIFFH,TITE,DPSISF,DPSILF,PSIM,APSI,APSIM,TPD(10),    CTQD0760
     7           PPD(10),NPD,KCOUNT,ISKIDP,ISMAIN,IGEAR,WEIGHT(10),    CTQD0770
     8           DEND                                                  CTQD0780
      DIMENSION VGRU(3),VGRD(3),GEAR(4)                                 CTQD0790
      EQUIVALENCE (VGRU(1),VGR12),(VGRD(1),VGR43),(GEAR(1),GEAR1)       CTQD0800
       TSEC = T                                                         CTQD0810
C     JDEND SIGNIFIES 'DRIVE' END OF VEHICLE, =1 FOR FRONT, =2 FOR REAR CTQD0820
      IF(JDEND.EQ.1) L = 1                                              CTQD0830
      IF(JDEND.EQ.2) L = 3                                              CTQD0840
       TQD(1) = 0.                                                      CTQD0850
       TQD(2) = 0.                                                      CTQD0860
      IF(IDRVER.NE.0) GO TO 50                                          CTQD0870
      IF(NTT1+NTT2+NTT3.EQ.0) GO TO 41                                  CTQD0880
       DO 10 I = 2,NTTS                                                 CTQD0890
      IA=I - 1                                                          CTQD0900
      RATIO = 0.0                                                       CTQD0910
      PC=TPC(IA)                                                        CTQD0920
      TTTS = TTS(IA)                                                    CTQD0930
      TTTR = TTR(IA)                                                    CTQD0940
      IF((TSEC.GT.TT(I-1)).AND.(TSEC.LT.TT(I))) GO TO 14                CTQD0950
      IF(TSEC.GT.TT(NTTS)) GO TO 11                                     CTQD0960
       IF(TSEC.EQ.TT( IA)) GO TO 21                                     CTQD0970
      IF(TSEC.EQ.TT(I)) GO TO 20                                        CTQD0980
   10 CONTINUE                                                          CTQD0990
   11 TTTR = TTR(NTTS)                                                  CTQD1000
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```
      PRINT 12,TSEC,TTTR
   12 FORMAT(1H0,3X,'TSEC NOT WITHIN RANGE OF TABULAR VALUES TSEC =',
     1 E15.8,'SET TRANSMISSION RATIO,TTTR=',E15.8)
            NTTS IS THE LARGEST INTEGER IN  10.*(T1 + DT)  + 1.
          TO AVOID OUT-OF-RANGE MESSAGES, USE
C           NTTS IS THE LARGEST INTEGER IN  10.*(T1 + DT)  + 2.
       GO TO 20
   14 RATIO = (TSEC-TT(IA))/(TT(IA+1)-TT(IA))
      TTTR = TTR(IA)+RATIO*(TTR(IA+1)-TTR(IA))
C  WHEN RATIO IS .GT. 0.5 SET TTR TO NEXT VALUE IN TABLE
      IF(RATIO.GT.0.5) TTTR = TTR(IA+1)
C
C  PARI - FUNCTION SUBROUTINE TO DO LAGRANGIAN INTERPOLATION
C
      PC = PARI(NTTS,IA,TSEC,TT,TPC)
      IF(PC.LT.0.0) PC = 0.0
      TTTS = PARI(NTTS,IA,TSEC,TT,TTS)
      IF(TTTS.LT.0.0) TTTS = 0.0
       GO TO 21
   20 TTTR = TTR(IA+1)
      TTTS = TTS(IA+1)
      PC = TPC(IA+1)
      GO TO 21
C DRIVER CONTROLS CONVERTED HERE
   50 TTTS = APD/APDMAX
      IF(TTTS.LT.0.0) TTTS = 0.0
      PC = BFP1*FBRK+BFP2*FBRK**2
      IF(PC.LT.0.0) PC = 0.0
      TTTR = GEAR(IGEAR)
      RPME = PI015R*ARBR(JDEND)*TTTR*(RPSI(L)+RPSI(L+1))
      IF(TQE.LT.0.0) GO TO 55
      IF(RPME.LT.VGRU(IGEAR)) GO TO 57
      IGEAR = IGEAR+1
      TTTR = GEAR(IGEAR)
      GO TO 21
   55 IF(IGEAR.EQ.1) GO TO 57
      IF(RPME.GT.VGRD(5-IGEAR)) GO TO 57
      IGEAR = IGEAR-1
      TTTR = GEAR(IGEAR)
   21 RPME = PI015R*ARBR(JDEND)*TTTR*(RPSI(L)+RPSI(L+1))
   57 CONTINUE
      IF(RPME.EQ.0.0) GO TO 41
      IF((RPME.GT.0.).AND.(RPME.LT.500.0)) RPME = 500.0
      DO 30 I=2,NRPM
      IA = I - 1
       TEST = ABS(RPME-TRPME(IA))
       IF(TEST.GT.0.05) GO TO 27
   24 TQWOT = TWOT(IA)
      TQCT  = TCT(IA)
      GO TO 37
   27 IF((RPME.GT.TRPME( IA)).AND.(RPME.LT.TRPME(I))) GO TO 34
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30 CONTINUE
   IA = NRPM
    GO TO 24
34 RATIO = (RPME-TRPME(IA))/(TRPME(IA+1)-TRPME(IA))
   TQWOT = TWOT(IA)+RATIO*(TWOT(IA+1)-TWOT(IA))
   TQCT = TCT(IA)+RATIO*(TCT(IA+1)-TCT(IA))
37 TQE = TQCT + TTTS * (TQWOT - TQCT)
   IF(RPME.GT.500.0) GO TO 40
   IF(PC .GT. 10.0) TTTR = 0.0
40 TQD(JDEND) = TQE * TTTR
41 RETURN
   END
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      SUBROUTINE DAUX
C     HVOSM-VD2 VERSION
C     REVISED OCTOBER 1975   CALSPAN CORPORATION
      COMMON/INPT/PHIO,THETAO,PSIO,PO,QO,RO,XCOP,YCOP,ZCOP,UO,VO,WO,
     1          A,B,DEL10,DEL20,DEL30,PHIRO,DEL10D,DEL20D,DEL30D,
     2          PHIROD,TF,TR,ZF,ZR,RHO,AKRS,XMUR,
     3          XMS,XMUF,XIX,XIY,XIZ,XIXZ,CF,AKF,XLAMF,OMEGF,CFP,EPSF,
     4          RF,CR,AKR,XLAMR,OMEGR,CRP,EPSR,RR,TS,THMAX,DTCOMP,TO,
     5          T1,DTCMP1,DTPRNT,MODE,EBAR,EM,AAA,HMAX,HMIN,BET,G,
     6          HED(36),DADE(3),X1R,X1,Y1,Z1,X2,Y2,Z2,PHIC(50),DELB,
     7          DELE,DDEL,NDEL,PSIF(50),TQF(50),TQR(50),TB,TE,TINCR,
     8          NZTAB,NZ5,XBDRY(4,5),PSBDRY(4,5),YBDRY(2,5),NBX(5),
     9          NBY(5),NTBL1,NTBL2,NTBL3,ZGP(21,21,5)
      COMMON/INPT/XB(5),XE(5),XINCR(5),NX(5),YB(5),YE(5),YINCR(5),NY(5),
     1        XXZGP5(21),YYZGP5(21),AMUG(5),PSEDRO(4,5),UVWMIN,PQRMIN
      COMMON/INPT1/YC1P,YC2P,ZC2P,DELTC,PHIC1,PHIC2,AMUC,XIPS,
     1           CPSP,OMGPS,AKPS,EPSPS,XPS,RWHJB,RWHJE,DRWHJ,INDCRB,
     2           PSIFIO,PSIFDO
      DIMENSION YCIP(2)
      EQUIVALENCE (YCIP(1),YC1P)
      COMMON /INTG/NEQ,T,DT,VAR(50),DER(50)
      EQUIVALENCE (U,VAR(1)),(V,VAR(2)),(W,VAR(3)),(P,VAR(4)),(Q,VAR(5))
     1          ,(R,VAR(6)),(DEL1,VAR(7)),(DEL1D,VAR(8)),(DEL2,VAR(9)),
     2          (DEL2D,VAR(10)),(DEL3,VAR(11)),(DEL3D,VAR(12)),
     3          (PHIR,VAR(13)),(PHIRD,VAR(14)),(THETTP,VAR(15)),
     4          (PHITP,VAR(16)),(PSITP,VAR(17)),(XCP,VAR(18)),
     5          (YCP,VAR(19)),(ZCP,VAR(20)),(PSIFI,VAR(21)),
     6          (PSIFID,VAR(22))
      EQUIVALENCE (DU,DER(1)),(DV,DER(2)),(DW,DER(3)),(DP,DER(4)),
     1          (DQ,DER(5)),(DR,DER(6)),(DDEL1,DER(7)),(DDEL1D,DER(8))
     2          ,(DDEL2,DER(9)),(DDEL2D,DER(10)),(DDEL3,DER(11)),
     3          (DDEL3D,DER(12)),(DPHIR,DER(13)),(DPHIRD,DER(14)),
     4          (DTHTTP,DER(15)),(DPHITP,DER(16)),(DPSITP,DER(17)),
     5          (DXCP,DER(18)),(DYCP,DER(19)),(DZCP,DER(20)),
     6          (DPSIFI,DER(21)),(DDPSFI,DER(22))
      EQUIVALENCE (VAR(9),PHIF),(VAR(10),PHIFD),(DER(9),DPHIF),
     1          (DER(10),DPHIFD)
      EQUIVALENCE (VAR(13),DEL4),(VAR(14),DEL4D),(DER(13),DDEL4),
     1          (DER(14),DDEL4D)
      COMMON /DIMV/X1P,X2P,X3P,X4P,Y1P,Y2P,Y3P,Y4P,Z1P,Z2P,Z3P,Z4P,PHI1,
     1           PHI2,PHI3,PHI4,PSI1,PSI2,PSI3,PSI4,CAYW(4),CBYW(4),
     2           CGYW(4),ZPGI(4),THGI(4),PHGI(4),CPG(4),SPG(4),CTG(4),
     3           STG(4),CAGZ(4),CBGZ(4),CGGZ(4),D1(4),D2(4),D3(4),
     4           XLM1(4),XLM2(4),XLM3(4),AMTX(3,3),CMTX(3,4),XGPP(4),
     5           YGPP(4),ZGPP(4),DMATX(10,11),DELTA(4),CAR(4),CBR(4),
     6           CGR(4),FR(4),HI(4),FC(4),TI(4),AX(4),BX(4),CX(4),
     7           CTXG(4),UG(4),STXG(4),AY(4),BY(4),CY(4),CPYG(4),
     8           SPYG(4),VG(4),PSIIP(4),PHICI(4),CAC(4),CBC(4),CGC(4),
     9           FCXU(4),FCYU(4),FCZU(4),FS(4),CAXW(4),CBXW(4),CGXW(4)
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      COMMON /DIMV/AS(4),BS(4),CS(4),CAS(4),CBS(4),CGS(4),BETP(4),       DAUX0500
     1            BETBR(4),FSXU(4),FSYU(4),FSZU(4),FRXU(4),FRYU(4),      DAUX0510
     2            FRZU(4),FXU(4),FYU(4),FZU(4),SI(4),F1FI(2),F1RI(2),    DAUX0520
     3            F2FI(2),F2RI(2),CAH(4),CBH(4),CGH(4)                   DAUX0530
      DIMENSION XP(4),YP(4),ZP(4),PHII(4),PSII(4)                        DAUX0540
      EQUIVALENCE (XP(1),X1P),(YP(1),Y1P),(ZP(1),Z1P),(PHII(1),PHI1),    DAUX0550
     1           (PSII(1),PSI1)                                          DAUX0560
      COMMON /COMP/SUMM,THETN,PHIN,PSIN,PI,RAD,GAM1,GAM2,GAM3,GAM4,GAM5,DAUX0570
     1           GAM6,GAM7,GAM8,GAM9,THETT,PHIT,PSIT,ZRO,TRO2,           DAUX0580
     2            TFO2,TIZ,RHO2,RHOMUR,AMUF,BMUR,ZPR,TM4,RHMR2,AO2APB,   DAUX0590
     3            BO2APB,RFTF,TSO2,RRTS,BROMUR,XMUFO2,AXMFO2,XMTFO4,     DAUX0600
     4            XIZR,RTR,RHMP2I,XIXP,XIZP,XIXZP,XIYZP,D1PD2,D1MD2,     DAUX0610
     5            ZRO3,ZRO3R,ZFO3R,ZFO12,TIZ2,TG61,DD1P2,DD1M2,RPR,PHRPDAUX0620
     6           ,TANTP,SPHTP,CPHTP,SECTP,SFXS,SFYS,SFZS,SNPS,SNTS,      DAUX0630
     7            SNPSS,TPR,CAY,CBY,CGY,CAX,CBX,CGX,SFYU,SFXU,SFYUF,     DAUX0640
     8            SFYUR,SFZU,COSTH,SINTH,COSPS,SINPS,COSPH,SINPH,ANG1,   DAUX0650
     9            ANG2,CPHI,SPHI,CPSI,SPSI,P1,P7,P3,P4,P5,P6,TX,TY,TZ    DAUX0660
      COMMON /COMP/TRH,DISTX,DISTY,DISTD,DISTS,D21,ZETA4,ZETA4D,ZETA3,   DAUX0670
     1            ZETA3D,SFZ1,SNPU,SNTU,HCGH1,HCGH2,HCGH3,HCGH4,TERM1,   DAUX0680
     2            TERM2,SNPSU,SNPR,HCBH1,HCBH2,HCBH3,HCBH4,HCAH1,HCAH2,DAUX0690
     3            HCAH3,HCAH4,UQ,WP,UR,QR,VP,PR,P2,Q2,R2,VR,WQ,PQ,PHIR2DAUX0700
     4           ,PHIRD2,RPHRD,GCTH,GSTH,GCTSP,GCTCP,XXX,YYY,IX,IY,XX1,DAUX0710
     5            XX2,YY1,YY2,THG1,THG2,PHG1,PHG2,ZZ1,ZZ2,LLL            DAUX0720
      DIMENSION HCAH(4),HCBH(4),HCGH(4)                                  DAUX0730
      EQUIVALENCE (HCAH(1),HCAH1),(HCBH(1),HCBH1),(HCGH(1),HCGH1)        DAUX0740
      COMMON /COMPN/ FRSP(4),FRCP(4),ICBHIT,JCBHIT,                      DAUX0750
     1               DPSINT,TANPC1,TANPC2,PHIC1R,PHIC2R,AMUCMP,PHI1D,    DAUX0760
     2               PHI2D,LCB1(4),LCB2(4),IHIT,AJMTX(3,3),BMTX(3,3),    DAUX0770
     3               SFRX(4),SFRY(4),SFRZ(4),T1PSI,T2PSI,XMUGI(4)        DAUX0780
      LOGICAL LCB1,LCB2                                                  DAUX0790
      COMMON/ADTNL/ U1,U2,U3,U4,V1,V2,V3,V4,W1,W2,W3,W4,                 DAUX0800
     1              XIYP,SPHIC,CPHIC,APTCH1,APTCH2,APTCH3,APTCH4,        DAUX0810
     2              SLOPE1,SLOPE2,XTRA(300)                              DAUX0820
      DIMENSION UI(4),VI(4),WI(4)                                        DAUX0830
      EQUIVALENCE (UI(1),U1),(VI(1),V1),(WI(1),W1)                       DAUX0840
      DIMENSION APITCH(4)                                                DAUX0850
      EQUIVALENCE (APITCH(1),APTCH1)                                     DAUX0860
      COMMON /INPT4/ FIDJ(2),FIWJ(2),ARBR(2),NXUGMU,NXFRCP,XXUGMU(6),    DAUX0870
     A               XXFRCP(6),XMUMAT(6,6,4),XMXPMT(6,6,4),              DAUX0880
     B               XMXSMT(6,6,4),SLIPMT(6,6,4),CT(4),XMUM(4),          DAUX0890
     C               XMUXP(4),XMUXS(4),RRMC(4),RRM(4),COMEN4             DAUX0900
      EQUIVALENCE (FIDJ(1),FIDJF),(FIDJ(2),FIDJR),(FIWJ(1),FIWJF)        DAUX0910
      EQUIVALENCE (FIWJ(2),FIWJR),(ARBR(1),ARBRF),(ARBR(2),ARBRR)        DAUX0920
      COMMON /COMP4/FIDAR(2),FIDIW(2),FIDWR2(2),SPHICI(4),CPHICI(4),     DAUX0930
     1              TIHI(4),ARBRI(4), PSITEM(4),SLPFAC(4),DTSTEP,DTTEST,DAUX0940
     2       DTINT,TWOPIR,FRTEST(4),XMUI(4),FRCPMU(4),HRTERM,SLIP(4),    DAUX0950
     3              SLIPT(4),RHOS(4),EPSS(4),TERMP(4),TERMB(4),TERM(4),  DAUX0960
     4              EPSSFC,FSXFAC(4),FSYFAC(4),FSZFAC(4),FRXFAC(4),      DAUX0970
     5              FRYFAC(4),FRZFAC(4),FCXFAC(4),FCYFAC(4),FCZFAC(4),   DAUX0980
     6              SFCDTR(4),SFSDTR(4),SFRCPR(4),SSLIP(4),FCAV(4),      DAUX0990
     7              FSAV(4),FRCPAV(4),SLIPAV(4),RPSSM(4),FCSLSM(4),      DAUX1000
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     8          ARTQ6(4),TQFAC(4),ARFAC1(2),ARFAC2(2),RPSFA(2),RPSFB(2),
     9          RPSFC(2),RPSFD(2),HRPSFA(4),HRPSFB(4),HRPSFC(4),STEPD
      COMMON /COMP4/  XBRAK(16),IUVS(4),IUVB(4),IRPS,IDTCNT,ISTEP,ISTOP
      LOGICAL  IUVS,IUVB,IRPS
      COMMON /INTR/ NEQR,TIMR,DTR,VARR(12),DERR(12)
      DIMENSION RPSI(4),DRPSI(4)
      EQUIVALENCE(VARR(1),RPSI(1)),(DERR(1),DRPSI(1))
      COMMON /INSUS/ XIF,RHOF,TSF,PHIFO,PHIFOD,DEL40,DEL40D,ISUS,
     1               AKDS,AKDS1,AKDS2,AKDS3,PHIRC(50),DTHF(50),DTHR(50),
     2               NCAMF,NCAMR,NDTHF,NDTHR
      COMMON /SUSCMP/ XMURO2,BXMRO2,XMTRO4,ZFO,TSFO2,RHOF2,RHFMUF,
     1                RHF2MF,RF2MFI,RTF,RRTR,D3PD4,D3MD4,D43,DD3P4,
     2                DD3M4,ZFD1RF,ZRD34,RFPF,RPF2M,WFMF,PHFP,PHIF2,
     3                PHIFD2,RPHFD,ZFD1,ZFD2,ZRD4,TPF,SLOPE3,SLOPE4,
     4                PHI3D,PHI4D,DTHF1,DTHF2,DTHR3,DTHR4,DTDD1,
     5                DTDD2,DTDD3,DTDD4,FJF(4),SNPF
      DIMENSION DISP(4),VEL(4)
C
      IF(ISTOP.NE.0) RETURN
      CALL TMCNST
      IS1 = ISUS+1
      D12D22 = DEL1*DEL1 + DEL2*DEL2
      GO TO (10,11,12),IS1
   10 XIXP = XMUF*(ZF*(ZF+D1PD2)+.5*D12D22) + XMUR*ZRD3*ZRD3R
      XIYP = XIXP+RHOMUR*ZRD3R
      XIZP = TIZ+TIZ2
      XIXZP = AMUF*ZFD12 - BMUR*ZRD3
      XIYZP = TM4*D1MD2-RHOMUR*PHIR*ZRD3R
      GAM2 = XMUF*ZFD12+XMUR*ZRD3R
      GAM3 = GAM2-RHOMUR
      GAM4 = XIYZP+RHMR2*PHIR
      GAM5 = TIZ-XMUF*TFO2*TF-TIZ2
      GAM6 = XMUF*DD1P2+2.0*TG61
      GAM7 = XMUF*(ZF*DD1P2+DEL1*DEL1D+DEL2*DEL2D)+2.0*ZRD3*TG61
      GAM8 = 2.0*(TM4*DD1M2-RPR*TG61)
      GAM9 = AMUF*DD1P2 - 2.0*B*TG61
      GO TO 3
   11 XIXP = XMUFO2*(ZFD1*ZFD1+ZFD2*ZFD2) + XMURO2*(ZRD3*ZRD3+ZRD4*ZRD4)
      XIYP = XIXP
      XIZP = XMUF*(A*A+TFO2*TFO2) +XMUR*(B*B+TRO2*TRO2)
      XIXZP = AXMFO2*(ZFD1+ZFD2) -  BXMRO2*(ZRD3+ZRD4)
      XIYZP = XMTFO4*D1MD2 + XMTRO4*D3MD4
      GAM2 = XMUF*ZFD12 + XMUR*ZRD34
      GAM5 = XMUF*(A*A-TFO2*TFO2) + XMUR*(B*B-TRO2*TRO2)
      GAM6 = XMUF*DD1P2 + XMUR*DD3P4
      GAM7 = XMUF*(ZFD1*DEL1D+ZFD2*DEL2D) + XMUR*(ZRD3*DEL3D+ZRD4*DEL4D)
      GAM8 = XMUF*TFO2*DD1M2 + XMUR*TRO2*DD3M4
      GAM9 = AMUF*DD1P2 - BMUR*DD3P4
      GO TO 3
   12 XIXP = XMUF*ZFD1*ZFD1 + RHFMUF*ZFD1 + XMUR*ZRD3*ZRD3 + RHOMUR*ZRD3
      XIYP = XIXP + RHFMUF*ZFD1RF + RHOMUR*ZRD3R
```

```
      XIZP = XMUF*(A*A+RFPF*RFPF) + XMUR*(B*B+RPR*RPR)
      XIXZP = AMUF*ZFD1 - BMUR*ZRD3
      XIYZP = -XMUF*RFPF*ZFD1RF - XMUR*RPR*ZRD3R
      GAM2 = XMUF*ZFD1RF + XMUR*ZRD3R
      GAM3 = GAM2 - RHFMUF - RHOMUR
      GAM4 = XIYZP + RHF2MF*PHIF + RHMR2*PHIR
      GAM5 = XMUF*(A*A-RFPF*RFPF) + XMUR*(B*B-RPR*RPR)
      GAM6 = 2.0*WFMF + 2.0*TG61
      GAM7 = 2.0*ZFD1*WFMF + 2.0*ZRD3*TG61
      GAM8 = -2.0*RFPF*WFMF - 2.0*RPR*TG61
      GAM9 = 2.0*A*WFMF - 2.0*B*TG61
    3 CALL VPOS
      CALL VGORNT
      CALL CTQD
      CALL CTQB
      CALL TIRFR
      IF(ISTOP.NE.0) RETURN
      IF(ISUS.EQ.2) GO TO 20
      DISP(1) = DEL1
      DISP(2) = DEL2
      VEL(1) = DEL1D
      VEL(2) = DEL2D
      GO TO 21
   20 DISP(1) = DEL1+TSFO2*PHIF
      DISP(2) = DEL1-TSFO2*PHIF
      VEL(1) = DEL1D+TSFO2*PHIFD
      VEL(2) = DEL1D-TSFO2*PHIFD
      GO TO 22
   21 IF(ISUS.NE.1) GO TO 22
      DISP(3) = DEL3
      DISP(4) = DEL4
      VEL(3) = DEL3D
      VEL(4) = DEL4D
      GO TO 23
   22 DISP(3) = DEL3+TSO2*PHIR
      DISP(4) = DEL3-TSO2*PHIR
      VEL(3) = DEL3D+TSO2*PHIRD
      VEL(4) = DEL3D-TSO2*PHIRD
   23 CALL SUSFRC(DISP,VEL)
      CALL UMOMNT(ISUS)
      GO TO (30,31,32),IS1
   30 CALL MATRIX
      GO TO 34
   31 CALL MTRXIR
      GO TO 34
   32 CALL MTRXSF
   34 CALL SIMSOL(DMATX,10,10)
      DU = DMATX(1,11)
      DV = DMATX(2,11)
      DW = DMATX(3,11)
      DP = DMATX(4,11)
```

```
      DQ = DMATX(5,11)
      DR = DMATX(6,11)
      DXCP = AMTX(1,1)*U + AMTX(1,2)*V + AMTX(1,3)*W
      DYCP = AMTX(2,1)*U + AMTX(2,2)*V + AMTX(2,3)*W
      DZCP = AMTX(3,1)*U + AMTX(3,2)*V + AMTX(3,3)*W
      DTHTTP = Q*CPHTP - R*SPHTP
      DPHITP = P + (Q*SPHTP + R*CPHTP)*TANTP
      DPSITP = (Q*SPHTP + R*CPHTP)*SECTP
      IF(ISUS.EQ.2) GO TO 40
      DDEL1D = DMATX(7,11)
      DDEL2D = DMATX(8,11)
      DDEL1 = DEL1D
      DDEL2 = DEL2D
      GO TO 41
   40 DDEL1D = DMATX(7,11)
      DPHIFD = DMATX(8,11)
      DDEL1 = DEL1D
      DPHIF = PHIFD
      GO TO 43
   41 IF(ISUS.NE.1) GO TO 43
      DDEL3D = DMATX(9,11)
      DDEL4D = DMATX(10,11)
      DDEL3 = DEL3D
      DDEL4 = DEL4D
      GO TO 44
   43 DDEL3D = DMATX(9,11)
      DPHIRD = DMATX(10,11)
      DDEL3 = DEL3D
      DPHIR = PHIRD
   44 CONTINUE
      IF(IHIT.EQ.0.AND.INDCRB.GE.0) RETURN
      DPSIFI = PSIFID
      T1PSI = 0.0
      T2PSI = 0.0
      IF(ABS(PSIFID).GT.EPSPS) T1PSI = SIGN(CPSP,PSIFID)
      IF(SIGN(1.,PSIFID) .NE. SIGN(1.,PSIFI)) GO TO 7
      ABSPSF = ABS(PSIFI)
      IF(ABSPSF .GT. OMGPS) T2PSI=SIGN((AKPS*(ABSPSF-OMGPS)),PSIFI)
    7 DDPSFI = (FYU(1)*(HCAH1-XPS*COS(PSIIP(1))*CTXG(1))+
     1          FYU(2)*(HCAH2-XPS*COS(PSIIP(2))*CTXG(2))-
     2        FXU(1)*(HCBH1+PHI1*HCGH1)-FXU(2)*(HCBH2+PHI2*HCGH2)-
     3         T1PSI-T2PSI+FZU(1)*HCAH1*PHI1+FZU(2)*HCAH2*PHI2)/XIPS
     4 +((FIWJF*COS(PSIFI))/XIPS) *(RPSI(1)*(P+PHI1D)+RPSI(2)*(P+PHI2D))
C     IN STEER DEGREE OF FREEDOM,GYROSCOPIC PRECESSION OF SPINNING WHEELS
C          SEE CONTINUATION CARD 4 JUST ABOVE
      RETURN
      END
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      SUBROUTINE DAUXR(NTRA)                                            DAXR0010
C              HVOSM-VD2 VERSION                                        DAXR0020
C              REVISED OCTOBER 1975   CALSPAN CORPORATION               DAXR0030
      COMMON /DIMV/X1P,X2P,X3P,X4P,Y1P,Y2P,Y3P,Y4P,Z1P,Z2P,Z3P,Z4P,PHI1,DAXR0040
     1          PHI2,PHI3,PHI4,PSI1,PSI2,PSI3,PSI4,CAYW(4),CBYW(4),     DAXR0050
     2          CGYW(4),ZPGI(4),THGI(4),PHGI(4),CPG(4),SPG(4),CTG(4),DAXR0060
     3          STG(4),CAGZ(4),CBGZ(4),CGGZ(4),D1(4),D2(4),D3(4),       DAXR0070
     4          XLM1(4),XLM2(4),XLM3(4),AMTX(3,3),CMTX(3,4),XGPP(4),    DAXR0080
     5          YGPP(4),ZGPP(4),DMATX(10,11),DELTA(4),CAR(4),CBR(4),    DAXR0090
     6          CGR(4),FR(4),HI(4),FC(4),TI(4),AX(4),BX(4),CX(4),       DAXR0100
     7          CTXG(4),UG(4),STXG(4),AY(4),BY(4),CY(4),CPYG(4),        DAXR0110
     8          SPYG(4),VG(4),PSIIP(4),PHICI(4),CAC(4),CBC(4),CGC(4),DAXR0120
     9          FCXU(4),FCYU(4),FCZU(4),FS(4),CAXW(4),CBXW(4),CGXW(4)DAXR0130
      COMMON /DIMV/AS(4),BS(4),CS(4),CAS(4),CBS(4),CGS(4),BETP(4),      DAXR0140
     1          BETBR(4),FSXU(4),FSYU(4),FSZU(4),FRXU(4),FRYU(4),       DAXR0150
     2          FRZU(4),FXU(4),FYU(4),FZU(4),SI(4),F1FI(2),F1RI(2),     DAXR0160
     3          F2FI(2),F2RI(2),CAH(4),CBH(4),CGH(4)                    DAXR0170
      DIMENSION XP(4),YP(4),ZP(4),PHII(4),PSII(4)                       DAXR0180
      EQUIVALENCE (XP(1),X1P),(YP(1),Y1P),(ZP(1),Z1P),(PHII(1),PHI1),   DAXR0190
     1         (PSII(1),PSI1)                                           DAXR0200
      COMMON /COMPN/ FRSP(4),FRCP(4),ICBHIT,JCBHIT,                     DAXR0210
     1             DPSINT,TANPC1,TANPC2,PHIC1R,PHIC2R,AMUCMP,PHI1D,     DAXR0220
     2             PHI2D,LCB1(4),LCB2(4),IHIT,AJMTX(3,3),BMTX(3,3),     DAXR0230
     3             SFRX(4),SFRY(4),SFRZ(4),T1PSI,T2PSI,XMUGI(4)         DAXR0240
      LOGICAL LCB1,LCB2                                                 DAXR0250
      COMMON /TIRIN/ AKT(4),SIGT(4),XLAMT(4),A0(4),A1(4),A2(4),A3(4),   DAXR0260
     1             A4(4),OMEGT(4),AMU(4),RW(4),FJP(35,4),A234(4),       DAXR0270
     2             A12(4),OMT2A2(4),OMT2M1(4),A23(4),ITIR(4)            DAXR0280
      COMMON /INPT4/ FIDJ(2),FIWJ(2),ARBR(2),NXUGMU,NXFRCP,XXUGMU(6),   DAXR0290
     A             XXFRCP(6),XMUMAT(6,6,4),XMXPMT(6,6,4),               DAXR0300
     B             XMXSMT(6,6,4),SLIPMT(6,6,4),CT(4),XMUM(4),           DAXR0310
     C             XMUXP(4),XMUXS(4),RRMC(4),RRM(4),COMEN4              DAXR0320
      EQUIVALENCE (FIDJ(1),FIDJF),(FIDJ(2),FIDJR),(FIWJ(1),FIWJF)       DAXR0330
      EQUIVALENCE (FIWJ(2),FIWJR),(ARBR(1),ARBRF),(ARBR(2),ARBRR)       DAXR0340
      COMMON /COMP4/FIDAR(2),FIDIW(2),FIDWR2(2),SPHICI(4),CPHICI(4),    DAXR0350
     1            TIHI(4),ARBRI(4), PSITEM(4),SLPFAC(4),DTSTEP,DTTEST,DAXR0360
     2       DTINT,TWOPIR,FRTEST(4),XMUI(4),FRCPMU(4),HRTERM,SLIP(4),   DAXR0370
     3            SLIPT(4),RHOS(4),EPSS(4),TERMP(4),TERMB(4),TERM(4),   DAXR0380
     4            EPSSFC,FSXFAC(4),FSYFAC(4),FSZFAC(4),FRXFAC(4),       DAXR0390
     5            FRYFAC(4),FRZFAC(4),FCXFAC(4),FCYFAC(4),FCZFAC(4),    DAXR0400
     6            SFCDTR(4),SFSDTR(4),SFRCPR(4),SSLIP(4),FCAV(4),       DAXR0410
     7            FSAV(4),FRCPAV(4),SLIPAV(4),RPSSM(4),FCSLSM(4),       DAXR0420
     8         ARTQ6(4),TQFAC(4),ARFAC1(2),ARFAC2(2),RPSFA(2),RPSFB(2),DAXR0430
     9         RPSFC(2),RPSFD(2),HRPSFA(4),HRPSFB(4),HRPSFC(4),STEPD    DAXR0440
      COMMON /COMP4/  XBRAK(16),IUVS(4),IUVB(4),IRPS,IDTCNT,ISTEP,ISTOP DAXR0450
      LOGICAL  IUVS,IUVB,IRPS                                           DAXR0460
      COMMON/INPT5/ IBTYP(2),AK1,AK2,PONE,PTWO,PZERO(2),GN(16,2),ZETAB, DAXR0470
     1            CONE,CTWO,CTHREE,TAUA,TAU0(4),TLF(51),TTAU(51),       DAXR0480
     2            TRPME(12),TWOT(12),TCT(12),TT(101),TPC(101),TTR(101)DAXR0490
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     3             ,TTS(101),BTLF,ETLF,DTLF,NTLF,BRPM,ERPM,NRPM,
     4              BTT,ETT,DTT,NTT1,NTT2,NTT3,NTTS,XINPT5(9)
      COMMON/COMP5/ TAU(4),TQD(2),TQB(4),PP(2),TLAMB(2),PC,RWDRIV,JDEND,
     1             NETYP,ARFAC3(2),RPSFE(2),RHOSMX(3),SLIPMX(3),SLIPP,
     2              RHOMAX,RHOSAV(4),SRHOS(4),UGW(4),ABSUGW(4).VECS,
     3              DELTAE,PIO15R,COMEN5,TQE,RPME
      COMMON /INTR/ NEQR,TIMR,DTR,VARR(12),DERR(12)
      DIMENSION RPSI(4),DRPSI(4)
      EQUIVALENCE(VARR(1),RPSI(1)),(DERR(1),DRPSI(1))
      DIMENSION XMUX(4)
C
C
C         NOTE FRCP REQUIRES FS WHICH IS DETERMINED LATER. THE INITIALIZ
C             CALL SHOULD CORRECT THIS BY RECOMPUTING FS.
      DO 100 I=1,4
      IF (FR(I))  41,42,41
   41 FRTEST(I) =  (FR(I) - FS(I) * SPHICI(I))
      IF(FRTEST(I)) 42,42,45
   42 FC(I)= 0.0
      FS(I)= 0.0
      FRCP(I)= 0.0
      SLIP(I)    =  0.
      SLIPT(I) = 0.
      GO TO 100
   45 FRCP(I) = FRTEST(I) /CPHICI(I)
       VECS = SQRT(UG(I)**2 + VG(I)**2)
      ABSFRP = ABS(FRCP(I))
      XMRATO = XMUGI(I)/XMUM(I)
      CALL INTPR(XMUMAT,I,XXFRCP,XXUGMU,NXFRCP,NXUGMU,ABSFRP ,VECS,
     1              XNMY,XT1,6,6)
      CALL INTPR(XMXPMT,I,XXFRCP,XXUGMU,NXFRCP,NXUGMU,ABSFRP ,UGW(I),
     1              XNMXP,XT1,6,6)
      CALL INTPR(XMXSMT,I,XXFRCP,XXUGMU,NXFRCP,NXUGMU,ABSFRP ,UGW(I),
     1              XNMXS,XT1,6,6)
      CALL INTPR(SLIPMT,I,XXFRCP,XXUGMU,NXFRCP,NXUGMU,ABSFRP ,UGW(I),
     1              SLIPP,XT1,6,6)
      XMUI(I) = XNMY*XMRATO
      XMUXP(I) = XNMXP*XMRATO
      XMUXS(I) = XNMXS*XMRATO
      FRCPM   =    FRCP(I) * XMUI(I)
      FRCPMU(I) = FRCPM
      FC(I)= 0.0
      IF (IUVS(I)) GO TO 61
      HRTERM  = ABS( HI(I) * RPSI(I))
      IF (HRTERM - 0.5) 49,60,60
   49 SLIP(I) = 0.0
      GO TO 63
   60 SLIP(I) = -1.0 * SIGN(1.0,UGW(I))* SIGN(1.0,RPSI(I))
      GO TO 63
   61 SLIP(I) = 1.0  - RPSI(I) * SLPFAC(I)
   63 SLIPT(I) = ABS (SLIP(I))
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```
      IF( SLIPT(I) .GT. 1.0) SLIPT(I) = 1.0
      IF(SLIPT(I).EQ.1.0) SLIP(I) = SIGN(1.0,SLIP(I))
      CCT = CT(I)/FRCP(I)
      IF(SLIPT(I).GE.SLIPP) GO TO 73
      KK = 0
      RMU = 0.8
   70 SC2 = (RMU-1.0)*XMUXP(I)/(SLIPP-RMU*XMUXP(I)/CCT)**2
      SC1 = -2.0*SC2*SLIPP
      SC0 = XMUXP(I)+SC2*SLIPP**2
      IF(SC0.GT.0.1*XMUXP(I)) GOTO 71
      KK = KK+1
      IF(KK.GT.5) GO TO 999
      RMU = RMU+0.5*(1.0-RMU)
      GO TO 70
   71 SLIP1 = RMU*XMUXP(I)/CCT
      IF(SLIPT(I).GT.SLIP1) GO TO 72
      XMUX(I) = CCT*SLIPT(I)*SIGN(1.0,SLIP(I))
      GO TO 74
   72 XMUXT = SC0+SC1*SLIPT(I)+SC2*SLIPT(I)**2
      XMUX(I) = XMUXT*SIGN(1.0,SLIP(I))
      GO TO 74
   73 SC5 = (XMUXP(I)-XMUXS(I))/(SLIPP-1.0)**2
      SC4 = -2.0*SC5
      SC3 = XMUXS(I)+SC5
      XMUXT = SC3+SC4*SLIPT(I)+SC5*SLIPT(I)**2
      XMUX(I) = XMUXT*SIGN(1.0,SLIP(I))
   74 CONTINUE
      RHOS(I) = XMUX(I)/XMUI(I)
      RHOMAX = XMUXP(I)/XMUI(I)
   75 EPSS(I) = 1.0/RHOMAX**2
      IF(SLIPT(I).GT.SLIPP) EPSS(I) = 1.0/RHOS(I)**2
   77 FC(I) = -RHOS(I) * FRCPM      * SIGN(1.0,UGW(I))
      JFR = 1
      IF(I.GT.2) JFR = 2
      IF(PP(JFR)-PZERO(JFR)) 81,81,80
   80 FACTOR= (-FRCPM/SQRT(EPSS(I)+TERMP(I)))*SIGN(1.0,UGW(I))*SIGN(1.0,
     X   RHOS(I))
      IF (ABS(FACTOR) .LT. ABS(FC(I)))  FC(I)=FACTOR
C
   81 FS(I) = 0.0
      BETBR(I) = 0.0
      EPSSFC = EPSS(I) * FC(I)
      IF((EPSSFC*FC(I)).LT.(FRCPM*FRCPM-1.0)) GO TO 86
C              BETBR(I) SET TO CAUSE SKID INDICATION ON OUTPUT.
      BETBR(I) = 3.1
      GO TO 100
C          LOGICAL VARIABLE IUVB SET UP IN SUBROUTINE TIRFR FOR SIDE FOR
C        IF EITHER ABS(UG(I)).GT.0.5 OR ABS(VG(I)).GT.0.5, IUVB(I) IS TR
   86 IF( .NOT. IUVB(I)) GO TO 100
   87 FS(I) = SQRT(FRCPM*FRCPM  - EPSSFC*FC(I))
C       CORRECT FS FOR THE SIGN OF BETBR LATER.
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      IF(FRCP(I).GT.OMEGT(I)*A2(I)) GO TO 88
      BETP(I) = TERMB(I)*A234(I)*FRCP(I)*(A4(I)-FRCP(I)) /
     A         (A1(I)*FRCP(I)*(FRCP(I)-A2(I)) -A0(I)*A2(I))
      BETBR(I) = (TERM(I)+BETP(I)-PSITEM(I))*(A12(I)*FRCP(I)
     A        *(FRCP(I)-A2(I)) -A0(I)) / FS(I)
      GO TO 89
   88 BETP(I) = TERMB(I)*OMT2A2(I)
      BETBR(I) = (TERM(I)+BETP(I)-PSITEM(I))*
     A         (OMT2M1(I)-A0(I)) / FS(I)
   89 IF(ABS(BETBR(I)).LT.3.0)GO TO 90
      FS(I) = SIGN(FS(I),BETBR(I))
      GO TO 100
   90 FS(I) =FS(I)*(BETBR(I)-BETBR(I)*ABS(BETBR(I))/3. +BETBR(I)**3/27.)
  100 CONTINUE
C          AT 105 SET UP DIFFERENTIAL EQUATIONS FOR PINTIR
C
C  SUBROUTINE ADJTQB ADJUSTS BRAKE TORQUES AT EACH WHEEL
      IF(NTRA.EQ.2) CALL ADJTQB
      DO 107 I=1,4
      RRM(I) = 0.0
      IF(ABS(RPSI(I)).GT.ZETAB)RRM(I) =-RRMC(I)*FR(I)*SIGN(1.0,RPSI(I))
  107 CONTINUE
  105 J=0
      DO 110  I = 1,3, 2
      J= J + 1
      ARFTT = 6.0 * ARBR(J) * TQD(J)
      DRPSI(I)=RPSFA(J)*(12.*TQB(I)+ARFTT)-FC(I)*HI(I)*RPSFA(J)
     1  -RPSFB(J)*(12.0*TQB(I+1)+ARFTT)+FC(I+1)*HI(I+1)*RPSFB(J)
     2      +RPSFA(J)*RRM(I)-RPSFB(J)*RRM(I+1)
      DRPSI(I+1)=RPSFA(J)*(12.0*TQB(I+1)+ARFTT)-FC(I+1)*HI(I+1)*RPSFA(J)
     1          -RPSFB(J)*(12.0*TQB(I)+ARFTT) + FC(I) * HI(I) * RPSFB(J)
     2      +RPSFA(J)*RRM(I+1)-RPSFB(J)*RRM(I)
  110 CONTINUE
      RETURN
  999 WRITE(6,1000) I,CCT,XMUXP(I),KK,RMU,SC0,SC1,SC2
 1000 FORMAT(1H ,48HERROR IN CALCULATION OF XMUX, SUBROUTINE DAUXR   /
     A  5X,3HI =,I4,2X,5HCCT =,F8.3,2X,7HXMUXP =,F8.3,2X,4HKK =,I4,
     B  2X,5HRMU =,F8.4 / 5X,5HSC0 =,E12.6,2X,5HSC1 =,E12.6,
     C 2X,5HSC3 =,E12.6  )
      STOP
      END
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      SUBROUTINE DRIVER(PSIFF,PSIFFD,JJ)                                DRIV0010
C          HVOSM-VD2 VERSION                                            DRIV0020
C             REVISED OCTOBER 1975  CALSPAN CORPORATION                 DRIV0030
      COMMON/INPT1/YC1P,YC2P,ZC2P,DELTC,PHIC1,PHIC2,AMUC,XIPS,          DRIV0040
     1            CPSP,OMGPS,AKPS,EPSPS,XPS,RWHJB,RWHJE,DRWHJ,INDCRB,   DRIV0050
     2            PSIFIO,PSIFDO                                         DRIV0060
      DIMENSION YCIP(2)                                                 DRIV0070
      EQUIVALENCE (YCIP(1),YC1P)                                        DRIV0080
      COMMON /INTG/NEQ,T,DT,VAR(50),DER(50)                             DRIV0090
      EQUIVALENCE (U,VAR(1)),(V,VAR(2)),(W,VAR(3)),(P,VAR(4)),(Q,VAR(5))DRIV0100
     1          ,(R,VAR(6)),(DEL1,VAR(7)),(DEL1D,VAR(8)),(DEL2,VAR(9)),DRIV0110
     2           (DEL2D,VAR(10)),(DEL3,VAR(11)),(DEL3D,VAR(12)),        DRIV0120
     3           (PHIR,VAR(13)),(PHIRD,VAR(14)),(THETTP,VAR(15)),       DRIV0130
     4           (PHITP,VAR(16)),(PSITP,VAR(17)),(XCP,VAR(18)),         DRIV0140
     5           (YCP,VAR(19)),(ZCP,VAR(20)),(PSIFI,VAR(21)),           DRIV0150
     6           (PSIFID,VAR(22))                                       DRIV0160
      EQUIVALENCE (DU,DER(1)),(DV,DER(2)),(DW,DER(3)),(DP,DER(4)),      DRIV0170
     1           (DQ,DER(5)),(DR,DER(6)),(DDEL1,DER(7)),(DDEL1D,DER(8))DRIV0180
     2          ,(DDEL2,DER(9)),(DDEL2D,DER(10)),(DDEL3,DER(11)),       DRIV0190
     3           (DDEL3D,DER(12)),(DPHIR,DER(13)),(DPHIRD,DER(14)),     DRIV0200
     4           (DTHTTP,DER(15)),(DPHITP,DER(16)),(DPSITP,DER(17)),    DRIV0210
     5           (DXCP,DER(18)),(DYCP,DER(19)),(DZCP,DER(20)),          DRIV0220
     6           (DPSIFI,DER(21)),(DDPSFI,DER(22))                      DRIV0230
      COMMON /DIMV/X1P,X2P,X3P,X4P,Y1P,Y2P,Y3P,Y4P,Z1P,Z2P,Z3P,Z4P,PHI1,DRIV0240
     1            PHI2,PHI3,PHI4,PSI1,PSI2,PSI3,PSI4,CAYW(4),CBYW(4),   DRIV0250
     2            CGYW(4),ZPGI(4),THGI(4),PHGI(4),CPG(4),SPG(4),CTG(4),DRIV0260
     3            STG(4),CAGZ(4),CBGZ(4),CGGZ(4),D1(4),D2(4),D3(4),     DRIV0270
     4            XLM1(4),XLM2(4),XLM3(4),AMTX(3,3),CMTX(3,4),XGPP(4),  DRIV0280
     5            YGPP(4),ZGPP(4),DMATX(10,11),DELTA(4),CAR(4),CBR(4),  DRIV0290
     6            CGR(4),FR(4),HI(4),FC(4),TI(4),AX(4),BX(4),CX(4),     DRIV0300
     7            CTXG(4),UG(4),STXG(4),AY(4),BY(4),CY(4),CPYG(4),      DRIV0310
     8            SPYG(4),VG(4),PSIIP(4),PHICI(4),CAC(4),CBC(4),CGC(4),DRIV0320
     9            FCXU(4),FCYU(4),FCZU(4),FS(4),CAXW(4),CBXW(4),CGXW(4)DRIV0330
      COMMON /DIMV/AS(4),BS(4),CS(4),CAS(4),CBS(4),CGS(4),BETP(4),      DRIV0340
     1            BETBR(4),FSXU(4),FSYU(4),FSZU(4),FRXU(4),FRYU(4),     DRIV0350
     2            FRZU(4),FXU(4),FYU(4),FZU(4),SI(4),F1FI(2),F1RI(2),   DRIV0360
     3            F2FI(2),F2RI(2),CAH(4),CBH(4),CGH(4)                  DRIV0370
      DIMENSION XP(4),YP(4),ZP(4),PHII(4),PSII(4)                       DRIV0380
      EQUIVALENCE (XP(1),X1P),(YP(1),Y1P),(ZP(1),Z1P),(PHII(1),PHI1),   DRIV0390
     1           (PSII(1),PSI1)                                         DRIV0400
      COMMON /COMP/SUMM,THETN,PHIN,PSIN,PI,RAD,GAM1,GAM2,GAM3,GAM4,GAM5,DRIV0410
     1           GAM6,GAM7,GAM8,GAM9,THETT,PHIT,PSIT,ZRO,TRO2,          DRIV0420
     2            TFO2,TIZ,RHO2,RHOMUR,AMUF,BMUR,ZPR,TM4,RHMR2,AO2APB,  DRIV0430
     3            BO2APB,RFTF,TSO2,RRTS,BROMUR,XMUFO2,AXMFO2,XMTFO4,    DRIV0440
     4            XIZR,RTR,RHMR2I,XIXP,XIZP,XIX2P,XIYZP,D1PD2,D1MD2,    DRIV0450
     5            ZRD3,ZRD3R,ZFD3R,ZFD12,TIZ2,TG61,DD1P2,DD1M2,RPR,PHRPDRIV0460
     6           ,TANTP,SPHTP,CPHTP,SECTP,SFXS,SFYS,SFZS,SNPS,SNTS,     DRIV0470
     7            SNPSS,TPR,CAY,CBY,CGY,CAX,CBX,CGX,SFYU,SFXU,SFYUF,    DRIV0480
     8            SFYUR,SFZU,COSTH,SINTH,COSPS,SINPS,COSPH,SINPH,ANG1,  DRIV0490
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     9            ANG2,CPHI,SPHI,CPSI,SPSI,P1,P7,P3,P4,P5,P6,TX,TY,TZ
      COMMON /COMP/TRH,DISTX,DISTY,DISTD,DISTS,D21,ZETA4,ZETA4D,ZETA3,
     1            ZETA3D,SFZ1,SNPU,SNTU,HCGH1,HCGH2,HCGH3,HCGH4,TERM1,
     2            TERM2,SNPSU,SNPR,HCBH1,HCBH2,HCBH3,HCBH4,HCAH1,HCAH2,
     3            HCAH3,HCAH4,UQ,WP,UR,QR,VP,PR,P2,Q2,R2,VR,WQ,PQ,PHIR2
     4           ,PHIRD2,RPHRD,GCTH,GSTH,GCTSP,GCTCP,XXX,YYY,IX,IY,XX1,
     5            XX2,YY1,YY2,THG1,THG2,PHG1,PHG2,ZZ1,ZZ2,LLL
      DIMENSION HCAH(4),HCBH(4),HCGH(4)
      EQUIVALENCE (HCAH(1),HCAH1),(HCBH(1),HCBH1),(HCGH(1),HCGH1)
C      COMMON/EINDEX/ FOR EULER ANGLE INDEXING,MAIN,CNSTNT,DAUX,TMCNST
      COMMON/EINDEX/ TWOPI,PIO2,PIO4,XINDN,XINDL,THETTL,PHITL,PSITL,
     1               COSTHN,SINTHN,COSPSN,SINPSN,COSPHN,SINPHN,CTHETP,
     2               STHETP,CPSTP,SPSTP,BNMTX(3,3), CNMTX(3,3),ENDEIN
      COMMON/DRIVTT/TPATH,DELPTH,TCTEST(6),ITESTT,ITCHNG,IPATHT,IDRIVE,
     1               IDRVER,IBUG
C       IPATHT - STOP FOR DRIVER MODEL
C       IDRIVE - NOT ZERO, SAMPLE TIME FOR DRIVER MODEL
C       ITCHNG - NOT ZERO, CHANGE DESIRED SPEED AND DISTANCE
C       ITESTT,TCTEST(6) - INDEX AND INPUT TIMES FOR SPEED CHANGES
      COMMON/DRIVI/NEN,EMDT,ES,DS,APDMAX,FKDO,FKPO,FKS10,FKS20,FKSKDO,
     1            TESTBO,TSTS10,TSTS20,TSTR10,TSTR20,OMEGAO,TAUF,TIL,
     2            TL,S(5,2),NTRAN,YTRANS(6),GEAR1,GEAR2,GEAR3,GEAR4,
     3            VGR12,VGR23,VGR34,VGR43,VGR32,VGR21,
     4            TESTT(5),DESSI(5),DISTI(5),PSIFHO,XIMPOR(9),
     5            BFP1,BFP2,DRIEND
      COMMON/DRIVE/EN,FKD,FKP,FKS1,FKS2,FKSKID,TESTB,TESTS1,TESTS2,
     1            TESTR1,TESTR2,THESKD,FBRK,APB,DSOES,
     2            TRKIN,TMT,DESS,DIST,DISTC,CONMPH,UT,UTMPH,
     3            APD,DELTAX,DELTV,TJ,TTEM,TTPSIT,PSISKD,ST,STSO2,QAY,
     4            AXP,AYP,DI,UP,XVP,YVP,SLOPE,SLOPER,PSIJ,XINT,X,Y,
     5            TERMX,TERMY,TEMPOR,AE,EI,EWT,AREI(7),ARCAPE(7),ET,
     6            PSIFFH,TITE,DPSISF,DPSILF,PSIM,APSI,APSIM,TPD(10),
     7            PPD(10),NPD,KCOUNT,ISKIDP,ISMAIN,IGEAR,WEIGHT(10),
     8            DEND
C
      JJ = 1
      UT = SQRT(U*U+V*V+W*W)
C         CALCULATE AT INITIALIZATION AND ON IDRIVE = 1. IF NOT TIME
C         FOR DRIVER SAMPLE (IDRIVE.NE.1) BRANCH TO 50 AND CONTINUE
C         FILTER SUMMATION FOR PSIF. ALSO DONOT CHAGE APD,FBRK.
C         BRAKING, DRIVING TORQUE COMPUTED IN CTQB AND CTQD GIVEN
C         FBRK,APD.
      IF(IBUG.GT.1. OR.IBUG*IDRIVE.NE.0) WRITE(6,3001) T,IDRIVE
 3001 FORMAT(3H T=,F9.5,8H IDRIVE=,I2 )
      IF(IDRIVE.EQ.0) GO TO 50
  211 IDRIVE = 0
      THESKD = 0.0
      IF(U.NE.0.0.OR.V.NE.0.0) THESKD = ATAN2(V,U)
      IF(ISKIDP.EQ.2) GO TO 228
      IF(ABS(THESKD).GT.TESTR1) GO TO 225
      ISKIDP = 0
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      GO TO 215
  225 ISKIDP = 1
      APD = 0.0
      FBRK = 0.0
      IF(IBUG.NE.0) WRITE(6,3005) T,THESKD,APD,FBRK,PSISKD,ISKIDP
 3005 FORMAT(3H T=,F9.5,' THESKD=',F10.4,' APD=',F8.2,' FBRK=',F8.2,
     X       ' PSISKD=',F10.4,' ISKIDP=',I4,' STMT 225' )
      IF(ABS(THESKD).LT.TESTR ) GO TO 300
      ISKIDP = 2
  228 PSISKD = FKSKID*(THESKD-PSIFF)
      IF(IBUG.NE.0) WRITE(6,3006) T,THESKD,APD,FBRK,PSISKD,ISKIDP
 3006 FORMAT(3H T=,F9.5,' THESKD=',F10.4,' APD=',F8.2,' FBRK=',F8.2,
     A       ' PSISKD='F10.4,' ISKIDP=',I4,' STMT 228' )
      GO TO 49
C        PSISKD IS AN ENTRY INTO PUSH-DOWN TABLE, BYPASS PATH FOLLOWING
C        PSIFF IS OUTPUT FROM PREVIOUS SAMPLE TIME FOR PATH FOLLOWING
C
C        ISKIDP NOT ZERO INDICATES PSISKD HAS BEEN USED INSTEAD OF
C               PATH FOLLOWER
C        VEHICLE ORIENTATION NOT TO CHANGE MORE THAN 90 DEG. IN A SKID
C
  215 CALL DRIVP
      IF(IBUG.NE.0)WRITE(6,3003) T,APD,FBRK
 3003 FORMAT(3H T=,F9.5,' APD=',F8.2,' FBRK=',F8.2, ' FROM DRIVP' )
  300 CONTINUE
      UPP = AMTX(1,1)*U+AMTX(1,2)*V+AMTX(1,3)*W
      VPP = AMTX(2,1)*U+AMTX(2,2)*V+AMTX(2,3)*W
      ST = DS/UT
      STSO2 = ST*ST/2.0
      QAY = UT*UT*PSIM/(APB*(1.0+FKD*UT**2))
      AXP = AMTX(1,2)*QAY
      AYP = AMTX(2,2)*QAY
      ET = 0.0
C        NEN IS NO. OF SAMPLE POINTS ALONG PROJESTED PATH (MAX.OF 7)
      DO 70 I=1,NEN
      DI = FLOAT(I)
      XVP = XCP+ST*DI*UPP+STSO2*DI**2*AXP
      YVP = YCP+ST*DI*VPP+STSO2*DI**2*AYP
      SLOPX = UPP+ST*DI*AXP
      SLOPY = VPP+ST*DI*AYP
      SLOPER = -(SLOPY/SLOPX)
C
C        PSIJ IS ANGLE OF ROTATION TO ACHIEVE NEW AXIS, Y", ALONG
C           THE ERROR LINE BY A CLOCKWISE ROTATION
C        THE PURPOSE IS TO HAVE THE SIGN OF THE ERROR IN THIS AXIS
C           SYSTEM INDICATE THE DIRECTION OF STEERING
C        PSIJJ FOR THE ERROR LINE, WHICH IS ANGLE OF PREDICTED PATH
C           + PI/2 .   BUT ROTATE BY (-PI+PSIJJ) WHICH IS ANGLE OF
C           PREDICTED PATH - PI/2   SINCE STEERING IS NEGATIVE
C           COUNTERCLOCKWISE BUT PSIJJ IS POSITIVE CLOCKWISE BY
C           MATHEMATICAL CONVENTION .
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C
      PSIJ = ATAN2(SLOPX,SLOPY) - PIU2
C
      XINT = XVP-SLOPER*YVP
C        SOLVE FOR X,Y COORD. ON CLOSEST VALID DESIRED PATH EQN.
C        IF NO SOLUTION, IPATHT = 1
      DO 60 J=1,5
      Y =  (S(J,1)-XINT)/(SLOPER-S(J,2))
      IF(Y.GT.YTRANS(J).AND.Y.LE.YTRANS(J+1)) GO TO 61
   60 CONTINUE
      IPATHT = 1
      WRITE(6,3010) T,IPATHT
 3010 FORMAT(3H T=,F9.5,' IPATHT=',I4,' NO SOLN. FOR ERROR' )
      RETURN
   61 X = S(J,1)+S(J,2)*Y
      TERMX = X-XVP
      TERMY = Y-YVP
      AE = SQRT(TERMX**2+TERMY**2)
      TEMPOR = SIN(PSIJ)*TERMX+COS(PSIJ)*TERMY
C        EI IS THE ITH ERROR, EWT IS THE WEIGHTED ITH ERROR
C        ET HOLDS ACCUMULATION OF WEIGHTED ERRORS
      EI = SIGN(AE,TEMPOR)
      EWT = EI*WEIGHT(I)
      AREI(I) = EI
      ARCAPE(I) = EWT
   70 ET = ET + EWT
      IF(IBUG.NE.0)WRITE(6,98)T,AREI,ARCAPE
   98 FORMAT(3H T=,F9.5,' EI=',7F10.3, /' EWT=',7F10.3 )
      DPSISF = FKP*ET
      IF(ABS(PSIFF).GE.OMGPS.AND.PSIFF*DPSISF.GT.0.0) GO TO 50
C        NPD = NO. OF DELTA-PSI'S IN PUSH-DOWN TABLE-PPD(I).
C        EACH DELTA-PSI HAS AN ASSOCIATED TIME-TPD(I)
      NPD = NPD+1
      PPD(NPD) = DPSISF
      TPD(NPD) = T
C        PSIM IS UNFILTERED PSIFF
      PSIM = PSIM + DPSISF
      GO TO 50
   49 IF(ABS(PSIFF).GE.OMGPS.AND.PSIFF*PSISKD.GT.0.0)GO TO 50
      NPD = NPD+1
      PPD(NPD) = PSISKD
      TPD(NPD) = T
      PSIM = PSIM + PSISKD
   50 KCOUNT = 0
      PSIFF = PSIFFH
      PSIFFD = 0.0
      IF(NPD.EQ.0) GO TO 75
      DO 74 J=1,NPD
      TITE = T-TPD(J)-TAUF
      IF(TITE.LT.0.0) GO TO 74
      IF(TITE.GE.1.0) GO TO 73
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 72 DPSILF = PPD(J)*(1.0-TMT*EXP(-TITE/TIL))
    PSIFF = PSIFF + DPSILF
    PSIFFD = PSIFFD+(PPD(J)-DPSILF)/TIL
    GO TO 74
 73 DPSILF = PPD(J)
    KCOUNT = KCOUNT+1
    PSIFF = PSIFF + DPSILF
 74 CONTINUE
    IF(KCOUNT.EQ.0) GO TO 75
    DO 16 J=1,KCOUNT
 16 PSIFFH = PSIFFH+PPD(J)
    NPD = NPD-KCOUNT
    DO 17 J=1,NPD
    PPD(J) = PPD(J+KCOUNT)
    TPD(J) = TPD(J+KCOUNT)
 17 CONTINUE
    KCOUNT = 0
 75 CONTINUE
C
    PSIJD = PSIJ/RAD
    IF(IBUG.GT.1.OR.IBUG*IDRIVE.NE.0) WRITE(6,97) T,PSIFF,
   X      PSIFFH,DPSILF,DPSISF,PSIJD,
   X                ISKIDP,NPD,(PPD(K),K=1,NPD),(TPD(K),K=1,NPD)
 97 FORMAT(3H T=,F9.5,' PSIFF=',F10.5,' PSIFFH=',F10.5,' DPSILF=',
   A        F10.5,' DPSISF=',F10.5,' PSIJD=',F10.5,,' ISKIDP=',I2,
   B        ' NPD=',I2  / ' PPD,TPD=', 10F10.5/' ',10F10.5 )
C
    APSI = ABS(PSIFF)
    IF(APSI.LE.OMGPS) GO TO 79
    PSIFF = SIGN(OMGPS,PSIFF)
 79 APSIM = ABS(PSIM)
    IF(APSIM.GT.OMGPS) PSIM=SIGN(OMGPS,PSIM)
    IF(ABS(PSIFFH).GT.OMGPS) PSIFFH=SIGN(OMGPS,PSIFFH)
 89 RETURN
    END
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      SUBROUTINE DRIVID                                                 DRVD0010
C              HVOSM-VD2 VERSION                                        DRVD0020
C              REVISED OCTOBER 1975   CALSPAN CORPORATION               DRVD0030
      COMMON/INPT/PHIO,THETAO,PSIO,PO,QO,RO,XCOP,YCOP,ZCOP,UO,VO,WO,    DRVD0040
     1         A,B,DEL10,DEL20,DEL30,PHIRO,DEL10D,DEL20D,DEL30D,        DRVD0050
     2         PHIROD,TF,TR,ZF,ZR,RHO,AKRS,XMUR,                        DRVD0060
     3         XMS,XMUF,XIX,XIY,XIZ,XIXZ,CF,AKF,XLAMF,OMEGF,CFP,EPSF,   DRVD0070
     4         RF,CR,AKR,XLAMR,OMEGR,CRP,EPSR,RR,TS,THMAX,DTCOMP,TO,    DRVD0080
     5         T1,DTCMP1,DTPRNT,MODE,EBAR,EM,AAA,HMAX,HMIN,BET,G,       DRVD0090
     6         HED(36),DADE(3),X1R,X1,Y1,Z1,X2,Y2,Z2,PHIC(50),DELB,     DRVD0100
     7         DELE,DDEL,NDEL,PSIF(50),TQF(50),TQR(50),TB,TE,TINCR,     DRVD0110
     8         NZTAB,NZ5,XBDRY(4,5),PSBDRY(4,5),YBDRY(2,5),NBX(5),      DRVD0120
     9         NBY(5),NTBL1,NTBL2,NTBL3,ZGP(21,21,5)                    DRVD0130
      COMMON/INPT/XB(5),XE(5),XINCR(5),NX(5),YB(5),YE(5),YINCR(5),NY(5),DRVD0140
     1        XXZGP5(21),YYZGP5(21),AMUG(5),PSBDRO(4,5),UVWMIN,PQRMIN   DRVD0150
      COMMON/HEAD/ VHED(20),CHED(20),GHED(20),SHED(20),THED(20),        DRVD0160
     1          NPAGE(20)                                               DRVD0170
      COMMON/DRIVTT/TPATH,DELPTH,TCTEST(6),ITESTT,ITCHNG,IPATHT,IDRIVE, DRVD0180
     1           IDRVER,IBUG                                            DRVD0190
C        IPATHT - STOP FOR DRIVER MODEL                                 DRVD0200
C        IDRIVE - NOT ZERO, SAMPLE TIME FOR DRIVER MODEL                DRVD0210
C        ITCHNG - NOT ZERO, CHANGE DESIRED SPEED AND DISTANCE           DRVD0220
C        ITESTT,TCTEST(6) - INDEX AND INPUT TIMES FOR SPEED CHANGES     DRVD0230
      COMMON/DRIVI/NEN,EMDT,ES,DS,APDMAX,FKDO,FKPO,FKS10,FKS20,FKSKDO,  DRVD0240
     1          TESTBO,TSTS10,TSTS20,TSTR10,TSTR20,OMEGAO,TAUF,TIL,     DRVD0250
     2          TL,S(5,2),NTRAN,YTRANS(6),GEAR1,GEAR2,GEAR3,GEAR4,      DRVD0260
     3          VGR12,VGR23,VGR34,VGR43,VGR32,VGR21,                    DRVD0270
     4          TESTT(5),DESSI(5),DIST1(5),PSIFHO,XIMPOR(9),            DRVD0280
     5          BFP1,BFP2,DRIEND                                        DRVD0290
      COMMON/DRIVE/EN,FKD,FKP,FKS1,FKS2,FKSKID,TESTB,TESTS1,TESTS2,     DRVD0300
     1          TESTR1,TESTR2,THESKD,FBRK,APB,DSDES,                    DRVD0310
     2          TRKIN,TMT,DESS,DIST,DISTC,CONMPH,UT,UTMPH,              DRVD0320
     3          APD,DELTAX,DELTV,TJ,TTEM,TTPSIT,PSISKD,ST,STSD2,QAY,    DRVD0330
     4          AXP,AYP,DI,UP,XVP,YVP,SLOPE,SLOPER,PSIJ,XINT,X,Y,       DRVD0340
     5          TERMX,TERMY,TEMPOR,AE,EI,EWT,AREI(7),ARCAPE(7),ET,      DRVD0350
     6          PSIFFH,TITE,DPSISF,DPSILF,PSIM,APSI,APSIM,TPD(10),      DRVD0360
     7          PPD(10),NPD,KCOUNT,ISKIDP,ISMAIN,IGEAR,WEIGHT(10),      DRVD0370
     8          DEND                                                    DRVD0380
      WRITE(6,1001) EN,EMDT,DS,TAUF,TIL,TL                              DRVD0390
 1001 FORMAT(1H0,                                                       DRVD0400
     A  9X,52HNO.OF SAMPLE POINTS ALONG PROJECTED PATH    EN      = ,   DRVD0410
     B  F8.2  /                                                         DRVD0420
     C 10X,52HTIME BETWEEN DRIVER SAMPLES                 EMDT    = ,   DRVD0430
     D  F6.2,2X,3HSEC    /                                              DRVD0440
     E 10X,52HINCREMENTAL DISTANCE ALONG PROJECTED PATH   DS      = ,   DRVD0450
     F  F8.2,2X,6HINCHES  /                                             DRVD0460
     G 10X,52HSTEERING FILTER TIME DELAY                  TAUF    = ,   DRVD0470
     H  F8.2,2X,3HSEC      /                                            DRVD0480
     I 10X,52HSTEERING FILTER TIME LAG                    TIL     = ,   DRVD0490
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    J  F8.2,2X,3HSEC      /                                              DRVD0500
    K 10X,52HSTEERING FILTER TIME LEAD                  TL     = ,      DRVD0510
    L  F8.2,2X,3HSEC      )                                              DRVD0520
     WRITE(6,1002) TESTS1,TESTS2,TESTB,TESTR1,TESTR2,FKP                DRVD0530
1002 FORMAT(1H ,                                                         DRVD0540
    A  9X,52HSPEED RESPONSE THRESHOLD                   TESTS1 = ,      DRVD0550
    B  F8.2,2X,6HIN/SEC  /                                               DRVD0560
    C 10X,52HSPEED RESPONSE INDIFFERENCE LEVEL          TESTS2 = ,      DRVD0570
    D  F8.2,2X,6HIN/SEC  /                                               DRVD0580
    E 10X,52HBRAKE PEDAL APPLICATION INDIFFERENCE LEVEL  TESTB  = ,     DRVD0590
    F  F8.2,2X,9HIN/SEC**2  /                                            DRVD0600
    G 10X,52HSKID CONTROL THRESHOLD                     TESTR1 = ,      DRVD0610
    H  F8.2,2X,7HRADIANS    /                                            DRVD0620
    I 10X,52HSKID CONTROL INDIFFERENCE LEVEL            TESTR2 = ,      DRVD0630
    J  F8.2,2X,7HRADIANS    /                                            DRVD0640
    K 10X,52HCONTROL GAIN FOR FRONT WHEEL STEER ANGLE    FKP    = ,     DRVD0650
    L  F8.2,2X,6HRAD/IN      )                                           DRVD0660
     WRITE(6,1003) FKSKID,FKS1,FKS2,FKD                                  DRVD0670
1003 FORMAT(1H ,                                                         DRVD0680
    A  9X,52HSKID CONTROL GAIN                          FKSKID = ,      DRVD0690
    B  F8.2,2X,7HRAD/RAD    /                                            DRVD0700
    C 10X,52HSPEED RESPONSE BRAKE PEDAL FORCE GAIN       FKS1   = ,     DRVD0710
    D  F8.2,2X,12HLB/IN/SEC**2    /                                      DRVD0720
    E 10X,52HSPEED RESPONSE ACCELERATOR PEDAL GAIN       FKS2   = ,     DRVD0730
    F  F8.2,2X,12HIN/IN/SEC**2    /                                      DRVD0740
    G 10X,52HHANDLING QUALITY CONSTANT                  FKD    = ,      DRVD0750
    H  F8.2,2X,11H(SEC/IN)**2     )                                      DRVD0760
     WRITE(6,1004) APDMAX,BFP1,BFP2                                      DRVD0770
1004 FORMAT(1H ,                                                         DRVD0780
    A  9X,52HMAXIMUM ACCELERATOR PEDAL DEFLECTION        APDMAX = ,     DRVD0790
    B  F8.2,2X,6HINCHES       /                                          DRVD0800
    C 10X,52HBRAKE SYSTEM PRESSURE VS. BRAKE PEDAL       BPF1   = ,     DRVD0810
    D  F8.2,2X,6HPSI/LB      /                                           DRVD0820
    E 10X,52H    FORCE COEFFICIENTS                     BPF2   = ,      DRVD0830
    F  F8.2,2X,9HPSI/LB**2  /     )                                      DRVD0840
     WRITE(6,1005)                                                       DRVD0850
1005 FORMAT(1H0,                                                         DRVD0860
    A 1X,49H          DESIRED PATH DATA                       ,         DRVD0870
    B     30H       SPEED CHANGE DATA        ,                           DRVD0880
    C     32H        IMPORTANCE       ERROR    ,   /                     DRVD0890
    D 1X,49H   Y' TRANSITION    X' INTERCEPT   SLOPE          ,         DRVD0900
    E     30H TIME    DESIRED     NULL     ,                             DRVD0910
    F     32H          WEIGHTING    WEIGHTING ,   /                      DRVD0920
    G 1X,49H          POINTS                                  ,         DRVD0930
    H     30H            SPEED   DISTANCE  ,                             DRVD0940
    I     32H           FUNCTION     FUNCTION      )                     DRVD0950
     WRITE(6,1008)                                                       DRVD0960
1008 FORMAT(1H ,                                                         DRVD0970
    A 1X,49H        YTRANS          S(I,1)      S(I,2)        ,         DRVD0980
    B     30H  TESTT    DESSI       DISTI    ,  /                        DRVD0990
    C 1X,49H          IN              IN                      ,         DRVD1000
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   D    30H   SEC    IN/SEC          IN     ,  /  )                         DRVD1010
     WRITE(6,1006) (YTRANS(I),S(I,1),S(I,2),TESTT(I),DESSI(I),DISTI(I),DRVD1020
   A               XIMPOR(I),WEIGHT(I),I=1,5)                               DRVD1030
1006 FORMAT(8X,F8.2,4X,F10.2,4X,F8.2,8X,F8.2,2X,F8.2,2X,F8.2,10X,F8.2, DRVD1040
   A       6X,F8.2 )                                                        DRVD1050
     WRITE(6,1007) (XIMPOR(I),WEIGHT(I),I=6,7)                              DRVD1060
1007 FORMAT(88X,F8.2,6X,F8.2 )                                              DRVD1070
     WRITE(6,1009) GEAR1,VGR12,VGR43,GEAR2,VGR23,VGR32,                     DRVD1080
   1               GEAR3,VGR34,VGR21,GEAR4                                  DRVD1090
1009 FORMAT(1H0,                                                            DRVD1100
   A  9X,50HTRANSMISSION      ENGINE UPSHIFT   ENGINE DOWNSHIFT   /         DRVD1110
   B 10X,50H GEAR RATIO       SPEED - RPME      SPEED - RPME      //        DRVD1120
   C 10X,5H1ST =,F7.3,5X,7HVGR12 =,F7.1,4X,7HVGR43 =,F7.1 /                 DRVD1130
   D 10X,5H2ND =,F7.3,5X,7HVGR23 =,F7.1,4X,7HVGR32 =,F7.1 /                 DRVD1140
   E 10X,5H3RD =,F7.3,5X,7HVGR34 =,F7.1,4X,7HVGR21 =,F7.1 /                 DRVD1150
   F 10X,5H4TH =,F7.3    )                                                  DRVD1160
     RETURN                                                                 DRVD1170
     END                                                                    DRVD1180
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```
      SUBROUTINE DRIVP
C              HVOSM-VD2 VERSION
C              REVISED OCTOBER 1975   CALSPAN CORPORATION
      COMMON/DRIVTT/TPATH,DELPTH,TCTEST(6),ITESTT,ITCHNG,IPATHT,IDRIVE,
     1              IDRVER,IBUG
C        IPATHT - STOP FOR DRIVER MODEL
C        IDRIVE - NOT ZERO, SAMPLE TIME FOR DRIVER MODEL
C        ITCHNG - NOT ZERO, CHANGE DESIRED SPEED AND DISTANCE
C        ITESTT,TCTEST(6) - INDEX AND INPUT TIMES FOR SPEED CHANGES
      COMMON/DRIVI/NEN,EMDT,ES,DS,APDMAX,FKDO,FKPO,FKS10,FKS20,FKSKDO,
     1              TESTBO,TSTS10,TSTS20,TSTR10,TSTR20,OMEGAO,TAUF,TIL,
     2              TL,S(5,2),NTRAN,YTRANS(6),GEAR1,GEAR2,GEAR3,GEAR4,
     3              VGR12,VGR23,VGR34,VGR43,VGR32,VGR21,
     4              TESTT(5),DESSI(5),DISTI(5),PSIFHO,XIMPOR(9),
     5              BFP1,BFP2,DRIEND
      COMMON/DRIVE/EN,FKD,FKP,FKS1,FKS2,FKSKID,TESTB,TESTS1,TESTS2,
     1              TESTR1,TESTR2,THESKD,FBRK,APB,DSDES,
     2              TRKIN,TMT,DESS,DIST,DISTC,CONMPH,UT,UTMPH,
     3              APD,DELTAX,DELTV,TJ,TTEM,TTPSIT,PSISKD,ST,STSD2,OAY,
     4              AXP,AYP,DI,UP,XVP,YVP,SLOPE,SLOPER,PSIJ,XINT,X,Y,
     5              TERMX,TERMY,TEMPOR,AE,EI,EWT,AREI(7),ARCAPE(7),ET,
     6              PSIFFH,TITE,DPSISF,DPSILF,PSIM,APSI,APSIM,TPD(10),
     7              PPD(10),NPD,KCOUNT,ISKIDP,ISMAIN,IGEAR,WEIGHT(10),
     8              DEND
C
C         ISMAIN NOT ZERO FOR SPEED MAINTENANCE, DO NOT UPDATE DIST
C
   10 IF(ISMAIN.NE.0) GO TO 15
      DIST = DIST-UT*EMDT
      IF(DIST.GT.0.0) GO TO 15
      DIST = DISTC
      ISMAIN = 1
C        NOTE: TESTT(1) MUST = TO
   15 IF(ITCHNG.EQ.0) GO TO 25
C         CHANGE DESIRED SPEED AND DISTANCE HERE
      ITTT = ITESTT-1
      IF(ITTT.GT.5) GO TO 25
      DESS = DESSI(ITTT)
      DISTC = DISTI(ITTT)
      DIST = DISTC
      ISMAIN = 0
      IF(IBUG.NE.0) WRITE(6,99) ITTT,DESS,DIST
   99 FORMAT(1H ,5X,6H ITTT=,I2,12H, DES.SPEED=,F10.3,7H, DIST=,F10.3)
   25 DELTV = DESS - UT
      FBRK = 0.0
      IF(DELTV.GE.0) GO TO 31
      IF(ABS(DELTV).GE.TESTS2) GO TO 32
C         NO CHANGE IN APD
   31 IF(DELTV.LT.TESTS1) GO TO 50
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   32 DELTAX = (DELTV*UT)/DIST                                          DRVP0500
      IF(DELTAX.GT.0.0) GO TO 45                                        DRVP0510
      IF(ABS(DELTAX).LE.TESTB) GO TO 45                                 DRVP0520
C        HERE DELTAX IS NEGATIVE, FKS1 IS INPUT AS POSITIVE,            DRVP0530
C        THEREFORE CHANGE SIGN TO GET POSITIVE PC IN CTQB               DRVP0540
      APD = 0.0                                                         DRVP0550
      FBRK =-FKS1*DELTAX                                                DRVP0560
      GO TO 50                                                          DRVP0570
C        AT STMT 45, ACCELERATION INCREASE, INCREASE ACC.PEDAL DEFL.    DRVP0580
C        OR IF DELAX NEGATIVE BUT NOT BRAKING, DECREASE APD.            DRVP0590
   45 APD = APD+FKS2*DELTAX                                             DRVP0600
      IF(APD) 46,50,47                                                  DRVP0610
   46 APD = 0.0                                                         DRVP0620
      GO TO 50                                                          DRVP0630
   47 IF(APD.GT.APDMAX) APD = APDMAX                                    DRVP0640
   50 RETURN                                                            DRVP0650
      END                                                               DRVP0660
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      SUBROUTINE DRVCNS                                                 DRVC0010
C           HVOSM-VD2 VERSION  -                                        DRVC0020
C           REVISED OCTOBER 1975   CALSPAN CORPORATION                  DRVC0030
      COMMON/INPT/PHIO,THETAO,PSIO,PO,QO,RO,XCOP,YCOP,ZCOP,UO,VO,WO,    DRVC0040
     1          A,B,DEL10,DEL20,DEL30,PHIRO,DEL10D,DEL20D,DEL30D,       DRVC0050
     2          PHIROD,TF,TR,ZF,ZR,RHO,AKRS,XMUR,                       DRVC0060
     3          XMS,XMUF,XIX,XIY,XIZ,XIXZ,CF,AKF,XLAMF,OMEGF,CFP,EPSF,DRVC0070
     4          RF,CR,AKR,XLAMR,OMEGR,CRP,EPSR,RR,TS,THMAX,DTCOMP,TO,   DRVC0080
     5          T1,DTCMP1,DTPRNT,MODE,EBAR,EM,AAA,HMAX,HMIN,BET,G,      DRVC0090
     6          HED(36),DADE(3),XIR,X1,Y1,Z1,X2,Y2,Z2,PHIC(50),DELB,    DRVC0100
     7          DELE,DDEL,NDEL,PSIF(50),TQF(50),TQR(50),TB,TE,TINCR,    DRVC0110
     8          NZTAB,NZ5,XBDRY(4,5),PSBDRY(4,5),YBDRY(2,5),NBX(5),     DRVC0120
     9          NBY(5),NTBL1,NTBL2,NTBL3,ZGP(21,21,5)                   DRVC0130
      COMMON/INPT/XB(5),XE(5),XINCR(5),NX(5),YB(5),YE(5),YINCR(5),NY(5),DRVC0140
     1         XXZGP5(21),YYZGP5(21),AMUG(5),PSBDRO(4,5),UVWMIN,PQRMIN  DRVC0150
      COMMON/INPT1/YC1P,YC2P,ZC2P,DELTC,PHIC1,PHIC2,AMUC,XIPS,          DRVC0160
     1           CPSP,OMGPS,AKPS,EPSPS,XPS,RWHJB,RWHJE,DRWHJ,INDCRB,    DRVC0170
     2           PSIFIO,PSIFDO                                          DRVC0180
      DIMENSION YCIP(2)                                                 DRVC0190
      EQUIVALENCE (YCIP(1),YC1P)                                        DRVC0200
      COMMON /COMP/SUMM,THETN,PHIN,PSIN,PI,RAD,GAM1,GAM2,GAM3,GAM4,GAM5,DRVC0210
     1          GAM6,GAM7,GAM8,GAM9,THETT,PHIT,PSIT,ZRO,TRO2,           DRVC0220
     2           TFO2,TIZ,RHC2,RHOMUR,AMUF,BMUR,ZPR,TM4,RHMR2,AO2APB,   DRVC0230
     3           BO2APB,RFTF,TSO2,RRTS,BROMUR,XMUFO2,AXMFO2,XMTFO4,     DRVC0240
     4           XIZR,RTR,RHMR2I,XIXP,XIZP,XIXZP,XIYZP,D1PD2,D1MD2,     DRVC0250
     5           ZRD3,ZRD3R,ZFD3R,ZFD12,TIZZ,TG61,DD1P2,DD1M2,RPR,PHRPDRVC0260
     6          ,TANTP,SPHTP,CPHTP,SECTP,SFXS,SFYS,SFZS,SNPS,SNTS,      DRVC0270
     7           SNPSS,TPR,CAY,CBY,CGY,CAX,CBX,CGX,SFYU,SFXU,SFYUF,     DRVC0280
     8           SFYUR,SFZU,COSTH,SINTH,COSPS,SINPS,COSPH,SINPH,ANG1,   DRVC0290
     9           ANG2,CPHI,SPHI,CPSI,SPSI,P1,P7,P3,P4,P5,P6,TX,TY,TZ    DRVC0300
      COMMON /COMP/TRH,DISTX,DISTY,DISTD,DISTS,D21,ZETA4,ZETA4D,ZETA3,  DRVC0310
     1           ZETA3D,SFZ1,SNPU,SNTU,HCGH1,HCGH2,HCGH3,HCGH4,TERM1,   DRVC0320
     2           TERM2,SNPSU,SNPR,HCBH1,HCBH2,HCBH3,HCBH4,HCAH1,HCAH2,DRVC0330
     3           HCAH3,HCAH4,UQ,WP,UR,QR,VP,PR,P2,Q2,R2,VR,WQ,PQ,PHIR2DRVC0340
     4          ,PHIRD2,RPHRD,GCTH,GSTH,GCTSP,GCTCP,XXX,YYY,IX,IY,XX1,DRVC0350
     5           XX2,YY1,YY2,THG1,THG2,PHG1,PHG2,ZZ1,ZZ2,LLL            DRVC0360
      DIMENSION HCAH(4),HCBH(4),HCGH(4)                                 DRVC0370
      EQUIVALENCE (HCAH(1),HCAH1),(HCBH(1),HCBH1),(HCGH(1),HCGH1)       DRVC0380
      COMMON /COMPN/ FRSP(4),FRCP(4),ICBHIT,JCBHIT,                     DRVC0390
     1             DPSINT,TANPC1,TANPC2,PHIC1R,PHIC2R,AMUCMP,PHI1D,     DRVC0400
     2             PHI2D,LCB1(4),LCB2(4),IHIT,AJMTX(3,3),BMTX(3,3),     DRVC0410
     3             SFRX(4),SFRY(4),SFRZ(4),T1PSI,T2PSI,XMUGI(4)         DRVC0420
      LOGICAL LCB1,LCB2                                                 DRVC0430
      COMMON /DIMV/X1P,X2P,X3P,X4P,Y1P,Y2P,Y3P,Y4P,Z1P,Z2P,Z3P,Z4P,PHI1,DRVC0440
     1           PHI2,PHI3,PHI4,PSI1,PSI2,PSI3,PSI4,CAYW(4),CBYW(4),    DRVC0450
     2           CGYW(4),ZPGI(4),THGI(4),PHGI(4),CPG(4),SPG(4),CTG(4),DRVC0460
     3           STG(4),CAGZ(4),CBGZ(4),CGGZ(4),D1(4),D2(4),D3(4),      DRVC0470
     4           XLM1(4),XLM2(4),XLM3(4),AMTX(3,3),CMTX(3,4),XGPP(4),   DRVC0480
     5           YGPP(4),ZGPP(4),DMATX(10,11),DELTA(4),CAR(4),CBR(4),   DRVC0490
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     6         CGR(4),FR(4),H1(4),FC(4),T1(4),AX(4),BX(4),CX(4),
     7         CTXG(4),UG(4),STXG(4),AY(4),BY(4),CY(4),CPYG(4),
     8         SPYG(4),VG(4),PSIIP(4),PHICI(4),CAC(4),CBC(4),CGC(4),
     9         FCXU(4),FCYU(4),FCZU(4),FS(4),CAXW(4),CBXW(4),CCXW(4)
      COMMON /DIMV/AS(4),BS(4),CS(4),CAS(4),CBS(4),CGS(4),BETP(4),
     1         BETBR(4),FSXU(4),FSYU(4),FSZU(4),FRXU(4),FRYU(4),
     2         FRZU(4),FXU(4),FYU(4),FZU(4),SI(4),F1FI(2),F1RI(2),
     3         F2FI(2),F2RI(2),CAH(4),CBH(4),CGH(4)
      DIMENSION XP(4),YP(4),ZP(4),PHII(4),PSII(4)
      EQUIVALENCE (XP(1),X1P),(YP(1),Y1P),(ZP(1),Z1P),(PHII(1),PHI1),
     1         (PSII(1),PSI1)
      COMMON /INPT4/ FIDJ(2),FIWJ(2),ARBR(2),NXUGMU,NXFRCP,XXUGMU(6),
     A           XXFRCP(6),XMUMAT(6,6,4),XMXPMT(6,6,4),
     B           XMXSMT(6,6,4),SLIPMT(6,6,4),CT(4),XMUM(4),
     C           XMUXP(4),XMUXS(4),RRMC(4),RRM(4),COMEN4
      EQUIVALENCE (FIDJ(1),FIDJF),(FIDJ(2),FIDJR),(FIWJ(1),FIWJF)
      EQUIVALENCE (FIWJ(2),FIWJR),(ARBR(1),ARBRF),(ARBR(2),ARBRR)
      COMMON/INPT5/ IBTYP(2),AK1,AK2,PONE,PTWO,PZERO(2),GN(16,2),ZETAE,
     1           CONE,CTWO,CTHREE,TAUA,TAUO(4),TLF(51),TTAU(51),
     2           TRPME(12),TWOT(12),TCT(12),TT(101),TPC(101),TTR(101)
     3         ,TTS(101),BTLF,ETLF,DTLF,NTLF,BRPM,ERPM,NRPM,
     4           BTT,ETT,DTT,NTT1,NTT2,NTT3,NTTS,XINPT5(9)
      COMMON/COMP5/ TAU(4),TQD(2),TQB(4),PP(2),TLAMB(2),PC,RWDRIV,JDEND,
     1           NBTYP,ARFAC3(2),RPSFE(2),RHOSMX(3),SLIPMX(3),SLIPP,
     2           RHOMAX,RHOSAV(4),SRHOS(4),UGW(4),ABSUGW(4),VECS,
     3           DELTAE,PIO15R,COMEN5,TQE,RPME
      COMMON /INTR/ NEQR,TIMR,DTR,VARR(12),DERR(12)
      DIMENSION RPSI(4),DRPSI(4)
      EQUIVALENCE(VARR(1),RPSI(1)),(DERR(1),DRPSI(1))
      COMMON/DRIVTT/TPATH,DELPTH,TCTEST(6),ITESTT,ITCHNG,IPATHT,IDRIVE,
     1           IDRVER,IBUG
C       IPATHT - STOP FOR DRIVER MODEL
C       IDRIVE - NOT ZERO, SAMPLE TIME FOR DRIVER MODEL
C       ITCHNG - NOT ZERO, CHANGE DESIRED SPEED AND DISTANCE
C       ITESTT,TCTEST(6) - INDEX AND INPUT TIMES FOR SPEED CHANGES
      COMMON/DRIVI/NEN,EMDT,ES,DS,APDMAX,FKDO,FKPO,FKS10,FKS20,FKSKDO,
     1          TESTBO,TSTS10,TSTS20,TSTR10,TSTR20,OMEGAO,TAUF,TIL,
     2         TL,S(5,2),NTRAN,YTRANS(6),GEAR1,GEAR2,GEAR3,GEAR4,
     3         VGR12,VGR23,VGR34,VGR43,VGR32,VGR21,
     4         TESTT(5),DESSI(5),DISTI(5),PSIFHO,XIMPOR(9),
     5         BFP1,BFP2,DRIEND
      COMMON/DRIVE/EN,FKD,FKP,FKS1,FKS2,FKSKID,TESTB,TESTS1,TESTS2,
     1          TESTR1,TESTR2,THESKD,FBRK,APB,DSGLS,
     2          TRKIN,TMT,DESS,DIST,DISTC,CONMPH,UT,UTMPH,
     3         APD,DELTAX,DELTV,TJ,TTEM,TTPSIT,PSISKD,ST,STSQ2,QAY,
     4         AXP,AYP,D1,UP,XVP,YVP,SLOPE,SLOPER,PSIJ,XINT,X,Y,
     5         TERMX,TERMY,TEMPOR,AE,EI,EWT,AREI(7),ARCAPE(7),ET,
     6         PSIFFH,TITE,DPSISF,DPSILF,PSIM,APSI,APSIM,TPD(10),
     7         PPD(10),NPD,KCOUNT,ISKIDP,ISMAIN,IGEAR,WEIGHT(10),
     8         DEND
      DIMENSION VGRU(3),VGRD(3),GEAR(4)
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      EQUIVALENCE (VGRU(1),VGR12),(VGRD(1),VGR43),(GEAR(1),GEAR1)         DRVC1010
C                                                                         DRVC1020
C        TRKIN IS JUST LARGER THAN T ON FIRST RK STEP. (HALF INTERVAL)    DRVC1030
      TRKIN = T0 + 0.51*DTCOMP                                            DRVC1040
      TTPSIT = PSI0*RAD                                                   DRVC1050
      CONMPH = 3600./(12.*5280.)                                          DRVC1060
      THESKD = 0.0                                                        DRVC1070
      FBRK = 0.0                                                          DRVC1080
      FKD = FKD0                                                          DRVC1090
      IF(OMGPS.EQ.0) OMGPS = 30.0*RAD                                     DRVC1100
      PSIFFH = PSIFI0                                                     DRVC1110
      APB = A+B                                                           DRVC1120
      FKP = (2.0*APB*(1.0+FKD*2.76E5))/(EN*DS*DS)                         DRVC1130
C         2.78E5 IS SQUARE OF 30 MPH IN IN/SEC                            DRVC1140
      DO 61 I=1,NEN                                                       DRVC1150
      DI = FLOAT(I)                                                       DRVC1160
   61 WEIGHT(I) = XIMPOR(I)/(DI*DI)                                       DRVC1170
      TMT = (TIL-TL)/TIL                                                  DRVC1180
C        TMT IS MULTIPIER FOR FITERING EQUATIN IN DRIVER                  DRVC1190
      FKS1 = FKS10                                                        DRVC1200
      FKS2 = FKS20                                                        DRVC1210
      FKSKID = FKSKD0                                                     DRVC1220
      TESTB = TESTB0                                                      DRVC1230
      TESTS1 = TSTS10                                                     DRVC1240
      TESTS2 = TSTS20                                                     DRVC1250
      TESTR1 = TSTR10                                                     DRVC1260
      TESTR2 = TSTR20                                                     DRVC1270
      IDRIVE = 1                                                          DRVC1280
      DELPTH = EMDT                                                       DRVC1290
      TPATH = T0 + DELPTH                                                 DRVC1300
C        IDRIVE, TPATH AND DELPTH USED TO DETERMINE DRIVER SAMPLE TIME    DRVC1310
C        ASSUME SPEED MAINTENANCE MODE UNTIL SECOND CHANGE TIME           DRVC1320
      DO 13 I=1,5                                                         DRVC1330
   13 TCTEST(I) = TESTT(I)                                                DRVC1340
      ISMAIN = 1                                                          DRVC1350
      ITCHNG = 0                                                          DRVC1360
      ITESTT = 2                                                          DRVC1370
      DESS = DESSI(1)                                                     DRVC1380
      DISTC = DISTI(1)                                                    DRVC1390
      DIST = DISTC                                                        DRVC1400
C        GET INITIAL APD FOR EQUILIBRIUM                                  DRVC1410
      L = 1                                                               DRVC1420
      IF(JDEND.EQ.2) L=3                                                  DRVC1430
      DO 10 I=1,4                                                         DRVC1440
   10 RPSI(I) = U0/HI(I)                                                  DRVC1450
      RPMOTR = PI015R*ARBR(JDEND)*(RPSI(L)+RPSI(L+1))                     DRVC1460
      DO 70 I=1,3                                                         DRVC1470
      IGEAR = I                                                           DRVC1480
      IF(RPMOTR*GEAR(I).LT.VGRU(I)) GO TO 71                              DRVC1490
   70 CONTINUE                                                            DRVC1500
      IGEAR = 4                                                           DRVC1510
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71 TTTR = GEAR(IGEAR)
   RPME = RPMOTR*TTTR
   DF = -CONE*UO*ABS(UO)-CTWO*UO-CTHREE*SIGN(1.,UO)
   DO 11 I=1,4
11 DF = DF-PRMC(I)*FR(I)/HI(I)
   TQD(JDEND) = -DF*0.5*(HI(L)+HI(L+1))/(ARBR(JDEND)*12.0)
   TQE = TQD(JDEND)/TTTR
   DO 30 I=2,NRPM
   IA = I-1
   TEST = ABS(RPME-TRPME(IA))
   IF(TEST.LT.0.05) GO TO 24
   IF(TRPME(IA).LE.RPME.AND.RPME.LT.TRPME(I)) GO TO 34
30 CONTINUE
   IA = NRPM
24 TQWOT = TWOT(IA)
   TQCT = TCT(IA)
   GO TO 37
34 RATIO = (RPME-TRPME(IA))/(TRPME(IA+1)-TRPME(IA))
   TQWOT = TWOT(IA)+RATIO*(TWOT(IA+1)-TWOT(IA))
   TQCT  = TCT(IA) +RATIO*(TCT(IA+1)-TCT(IA))
37 TTTS = (TQE-TQCT)/(TQWOT-TQCT)
   APD = TTTS*APDMAX
   RETURN
   END
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      SUBROUTINE GCP(I)                                                 GCP 0010
C              HVOSM-VD2 VERSION                                        GCP 0020
C              REVISED OCTOBER 1975   CALSPAN CORPORATION               GCP 0030
      COMMON /DIMV/X1P,X2P,X3P,X4P,Y1P,Y2P,Y3P,Y4P,Z1P,Z2P,Z3P,Z4P,PHI1,GCP 0040
     1              PHI2,PHI3,PHI4,PSI1,PSI2,PSI3,PSI4,CAYW(4),CBYW(4), GCP 0050
     2              CGYW(4),ZPGI(4),THGI(4),PHGI(4),CPG(4),SPG(4),CTG(4),GCP 0060
     3              STG(4),CAGZ(4),CBGZ(4),CGGZ(4),D1(4),D2(4),D3(4),   GCP 0070
     4              XLM1(4),XLM2(4),XLM3(4),AMTX(3,3),CMTX(3,4),XGPP(4), GCP 0080
     5              YGPP(4),ZGPP(4),DMATX(10,11),DELTA(4),CAR(4),CBR(4), GCP 0090
     6              CGR(4),FR(4),HI(4),FC(4),TI(4),AX(4),BX(4),CX(4),   GCP 0100
     7              CTXG(4),UG(4),STXG(4),AY(4),BY(4),CY(4),CPYG(4),    GCP 0110
     8              SPYG(4),VG(4),PSIIP(4),PHICI(4),CAC(4),CBC(4),CGC(4),GCP 0120
     9              FCXU(4),FCYU(4),FCZU(4),FS(4),CAXW(4),CBXW(4),CGXW(4)GCP 0130
      COMMON /DIMV/AS(4),BS(4),CS(4),CAS(4),CBS(4),CGS(4),BETP(4),      GCP 0140
     1              BETBR(4),FSXU(4),FSYU(4),FSZU(4),FRXU(4),FRYU(4),   GCP 0150
     2              FRZU(4),FXU(4),FYU(4),FZU(4),SI(4),F1FI(2),F1RI(2), GCP 0160
     3              F2FI(2),F2RI(2),CAH(4),CBH(4),CGH(4)                GCP 0170
      DIMENSION XP(4),YP(4),ZP(4),PHII(4),PSII(4)                       GCP 0180
      EQUIVALENCE (XP(1),X1P),(YP(1),Y1P),(ZP(1),Z1P),(PHII(1),PHI1),   GCP 0190
     1             (PSII(1),PSI1)                                       GCP 0200
      COMMON /COMP/SUMM,THETN,PHIN,PSIN,PI,RAD,GAM1,GAM2,GAM3,GAM4,GAM5,GCP 0210
     1             GAM6,GAM7,GAM8,GAM9,THETT,PHIT,PSIT,ZRO,TRO2,        GCP 0220
     2              TFO2,TIZ,RHO2,RHOMUR,AMUF,BMUR,ZPR,TM4,RHMR2,AO2APB, GCP 0230
     3              BO2APB,RFTF,TSO2,RRTS,BROMUR,XMUFO2,AXMFO2,XMTFO4,  GCP 0240
     4              XIZR,RTR,RHMR2I,XIXP,XIZP,XIXZP,XIYZP,D1PD2,D1MD2,  GCP 0250
     5              ZRD3,ZRD3R,ZFD3R,ZFD12,TIZ2,TG61,DD1P2,DD1M2,RPR,PHRPGCP 0260
     6             ,TANTP,SPHTP,CPHTP,SECTP,SFXS,SFYS,SFZS,SNPS,SNTS,   GCP 0270
     7              SNPSS,TPR,CAY,CBY,CGY,CAX,CBX,CGX,SFYU,SFXU,SFYUF,  GCP 0280
     8              SFYUR,SFZU,COSTH,SINTH,COSPS,SINPS,COSPH,SINPH,ANG1, GCP 0290
     9              ANG2,CPHI,SPHI,CPSI,SPSI,P1,P7,P3,P4,P5,P6,TX,TY,TZ GCP 0300
      COMMON /COMP/TRH,DISTX,DISTY,DISTD,DISTS,D21,ZETA4,ZETA4D,ZETA3,  GCP 0310
     1              ZETA3D,SFZ1,SNPU,SNTU,HCGH1,HCGH2,HCGH3,HCGH4,TERM1, GCP 0320
     2              TERM2,SNPSU,SNPR,HCBH1,HCBH2,HCBH3,HCBH4,HCAH1,HCAH2,GCP 0330
     3              HCAH3,HCAH4,UQ,WP,UR,QR,VP,PR,P2,Q2,R2,VR,WQ,PQ,PHIR2GCP 0340
     4             ,PHIRD2,RPHRD,GCTH,GSTH,GCTSP,GCTCP,XXX,YYY,IX,IY,XX1,GCP 0350
     5              XX2,YY1,YY2,THG1,THG2,PHG1,PHG2,ZZ1,ZZ2,LLL         GCP 0360
      DIMENSION HCAH(4),HCBH(4),HCGH(4)                                 GCP 0370
      EQUIVALENCE (HCAH(1),HCAH1),(HCBH(1),HCBH1),(HCGH(1),HCGH1)       GCP 0380
      COMMON /TIRIN/ AKT(4),SIGT(4),XLAMT(4),A0(4),A1(4),A2(4),A3(4),   GCP 0390
     1                A4(4),OMEGT(4),AMU(4),RW(4),FJP(35,4),A234(4),    GCP 0400
     2                A12(4),OMT2A2(4),OMT2M1(4),A23(4),ITIR(4)         GCP 0410
    1 XLM1(I) = XP(I)*CAYW(I)+YP(I)*CBYW(I)+ZP(I)*CGYW(I)               GCP 0420
      XLM2(I) = XP(I)*CAGZ(I)+YP(I)*CBGZ(I)+ZPGI(I)*CGGZ(I)             GCP 0430
      XLM3(I) = D1(I)*XP(I)+D2(I)*YP(I)+D3(I)*ZP(I)                     GCP 0440
    2 CMTX(1,1) = CAYW(I)                                               GCP 0450
      CMTX(1,2) = CBYW(I)                                               GCP 0460
      CMTX(1,3) = CGYW(I)                                               GCP 0470
      CMTX(1,4) = XLM1(I)                                               GCP 0480
      CMTX(2,1) = CAGZ(I)                                               GCP 0490
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      CMTX(2,2) = CBGZ(I)
      CMTX(2,3) = CGGZ(I)
      CMTX(2,4) = XLM2(I)
      CMTX(3,1) = D1(I)
      CMTX(3,2) = D2(I)
      CMTX(3,3) = D3(I)
      CMTX(3,4) = XLM3(I)
      CALL SIMSOL(CMTX,3,3)
    3 XGPP(I) = CMTX(1,4)
      YGPP(I) = CMTX(2,4)
      ZGPP(I) = CMTX(3,4)
      TX = XGPP(I)-XP(I)
      TY = YGPP(I)-YP(I)
      TZ = ZGPP(I)-ZP(I)
      DELTA(I) = SQRT(TX**2+TY**2+TZ**2)
      CAR(I) = TX/DELTA(I)
      CBR(I) = TY/DELTA(I)
      CGR(I) = TZ/DELTA(I)
      HI(I) = AMIN1(DELTA(I),RW(I))
    4 FR(I) = 0.0
      IF(RW(I).EQ.HI(I)) RETURN
      TRH = RW(I)-HI(I)
      IF(TRH.GT.SIGT(I)) GO TO 5
      FR(I) = AKT(I)*TRH
      RETURN
    5 FR(I) = AKT(I)*(XLAMT(I)*(TRH-SIGT(I))+SIGT(I))
      RETURN
      END
```

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      SUBROUTINE IDOUT                                                  IDOT0010
C           HVOSM-VD2 VERSION                                           IDOT0020
C               REVISED OCTOBER 1975  CALSPAN CORPORATION               IDOT0030
      COMMON/HEAD/ VHED(20),CHED(20),GHED(20),SHED(20),THED(20),        IDOT0040
     1             NPAGE(20)                                            IDOT0050
      COMMON/INPT/PHI0,THETA0,PSI0,P0,Q0,R0,XCOP,YCOP,ZCOP,U0,V0,W0,    IDOT0060
     1            A,B,DEL10,DEL20,DEL30,PHIR0,DEL10D,DEL20D,DEL30D,     IDOT0070
     2            PHIR0D,TF,TR,ZF,ZR,RHO,AKRS,XMUR,                     IDOT0080
     3            XMS,XMUF,XIX,XIY,XIZ,XIXZ,CF,AKF,XLAMF,OMEGF,CFP,EPSF,IDOT0090
     4            RF,CR,AKR,XLAMR,OMEGR,CRP,EPSR,RR,TS,THMAX,DTCOMP,T0, IDOT0100
     5            T1,DTCMP1,DTPRNT,MODE,EBAR,EM,AAA,HMAX,HMIN,BET,G,    IDOT0110
     6            HED(36),DADE(3),XIR,X1,Y1,Z1,X2,Y2,Z2,PHIC(50),DELB,  IDOT0120
     7            DELE,DDEL,NDEL,PSIF(50),TQF(50),TQR(50),TB,TE,TINCR,  IDOT0130
     8            NZTAB,NZ5,XBDRY(4,5),PSBDRY(4,5),YBDRY(2,5),NBX(5),   IDOT0140
     9            NBY(5),NTBL1,NTBL2,NTBL3,ZGP(21,21,5)                 IDOT0150
      COMMON/INPT/XB(5),XE(5),XINCR(5),NX(5),YB(5),YE(5),YINCR(5),NY(5),IDOT0160
     1          XXZGP5(21),YYZGP5(21),AMUG(5),PSBDRO(4,5),UVWMIN,PQRMIN IDOT0170
      COMMON/INPT1/YC1P,YC2P,ZC2P,DELTC,PHIC1,PHIC2,AMUC,XIPS,          IDOT0180
     1             CPSP,OMGPS,AKPS,EPSPS,XPS,RWHJB,RWHJE,DRWHJ,INDCRB,  IDOT0190
     2             PSIFI0,PSIFD0                                        IDOT0200
      DIMENSION YCIP(2)                                                 IDOT0210
      EQUIVALENCE (YC1P(1),YC1P)                                        IDOT0220
      COMMON /COMP/SUMM,THETN,PHIN,PSIN,P1,RAD,GAM1,GAM2,GAM3,GAM4,GAM5,IDOT0230
     1            GAM6,GAM7,GAM8,GAM9,THETT,PHIT,PSIT,ZR0,TR02,         IDOT0240
     2             TF02,TIZ,RH02,RHOMUR,AMUF,BMUR,ZPR,TM4,RHMR2,A02APB, IDOT0250
     3             B02APB,RFTF,TS02,RRTS,BROMUR,XMUF02,AXMF02,XMTF04,   IDOT0260
     4             XIZR,RTR,RHMR2I,XIXP,XIZP,XIXZP,XIYZP,D1PD2,D1MD2,   IDOT0270
     5             ZRD3,ZRD3R,ZFD3R,ZFD12,TIZ2,TG61,DD1P2,DD1M2,RPR,PHRPIDOT0280
     6            ,TANTP,SPHTP,CPHTP,SECTP,SFXS,SFYS,SFZS,SNPS,SNTS,    IDOT0290
     7             SNPSS,TPR,CAY,CBY,CGY,CAX,CBX,CGX,SFYU,SFXU,SFYUF,   IDOT0300
     8             SFYUR,SFZU,COSTH,SINTH,COSPS,SINPS,COSPH,SINPH,ANG1, IDOT0310
     9             ANG2,CPHI,SPHI,CPSI,SPSI,P1,P7,P3,P4,P5,P6,TX,TY,TZ  IDOT0320
      COMMON /COMP/TRH,DISTX,DISTY,DISTD,DISTS,D21,ZETA4,ZETA4D,ZETA3,  IDOT0330
     1             ZETA3D,SFZ1,SNPU,SNTU,HCGH1,HCGH2,HCGH3,HCGH4,TERM1, IDOT0340
     2             TERM2,SNPSU,SNPR,HCBH1,HCBH2,HCBH3,HCBH4,HCAH1,HCAH2,IDOT0350
     3             HCAH3,HCAH4,UQ,WP,UR,QR,VP,PR,P2,Q2,R2,VR,WQ,PQ,PHIR2IDOT0360
     4            ,PHIRD2,RPHRD,GCTH,GSTH,GCTSP,GCTCP,XXX,YYY,IX,IY,XX1,IDOT0370
     5             XX2,YY1,YY2,THG1,THG2,PHG1,PHG2,ZZ1,ZZ2,LLL          IDOT0380
      DIMENSION HCAH(4),HCBH(4),HCGH(4)                                 IDOT0390
      EQUIVALENCE (HCAH(1),HCAH1),(HCBH(1),HCBH1),(HCGH(1),HCGH1)       IDOT0400
      COMMON/INPT3/ AKFC,AKFCP,OMEGFC,AKFE,AKFEP,OMEGFE,AKRC,AKRCP,     IDOT0410
     1              OMEGRC,AKRE,AKREP,OMEGRE,END3                       IDOT0420
      COMMON/APTABL/ APFR(21,2),IAPFR(2),DAPFB,DAPFE,DDAPF,NAPF,        IDOT0430
     1               DAPRB,DAPRE,DDAPR,NAPR                             IDOT0440
      DIMENSION APF(21),APR(21)                                         IDOT0450
      EQUIVALENCE (APFR(1,1),APF(1)),(APFR(1,2),APR(1))                 IDOT0460
      COMMON /TIRIN/ AKT(4),SIGT(4),XLAMT(4),A0(4),A1(4),A2(4),A3(4),   IDOT0470
     1               A4(4),OMEGT(4),AMU(4),RW(4),FJP(35,4),A234(4),     IDOT0480
     2               A12(4),OMT2A2(4),OMT2M1(4),A23(4),ITIR(4)          IDOT0490
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      COMMON /INSUS/ XIF,RHOF,TSF,PHIFO,PHIFOD,DEL40,DEL40D,ISUS,
     1               AKDS,AKDS1,AKDS2,AKDS3,PHIRC(50),DTHF(50),DTHR(50),
     2               NCAMF,NCAMR,NDTHF,NDTHR
      COMMON/DRIVTT/TPATH,DELPTH,TCTEST(6),ITESTT,ITCHNG,IPATHT,IDRIVE,
     1              IDRVER,IBUG
C        IPATHT - STOP FOR DRIVER MODEL
C        IDRIVE - NOT ZERO, SAMPLE TIME FOR DRIVER MODEL
C        ITCHNG - NOT ZERO, CHANGE DESIRED SPEED AND DISTANCE
C        ITESTT,TCTEST(6) - INDEX AND INPUT TIMES FOR SPEED CHANGES
      COMMON /INPT4/ FIDJ(2),FIWJ(2),ARBR(2),NXUGMU,NXFRCP,XXUGMU(6),
     A               XXFRCP(6),XMUMAT(6,6,4),XMXPMT(6,6,4),
     B               XMXSMT(6,6,4),SLIPMT(6,6,4),CT(4),XMUM(4),
     C               XMUXP(4),XMUXS(4),RRMC(4),RRM(4),COMEN4
      EQUIVALENCE (FIDJ(1),FIDJF),(FIDJ(2),FIDJR),(FIWJ(1),FIWJF)
      EQUIVALENCE (FIWJ(2),FIWJR),(ARBR(1),ARBRF),(ARBR(2),ARBRR)
      COMMON/NEWCRB/ YC3P,YC4P,YC5P,YC6P,YCLP,
     1               ZC3P,ZC4P,ZC5P,ZC6P,ZCLP,
     2               PHIC3,PHIC4,PHIC5,PHIC6,NCRESL,
     3               TANPC3,TANPC4,TANPC5,TANPC6,TANPCL,
     4               PHIC3R,PHIC4R,PHIC5R,PHIC6R,PHICLR,
     5               YCMP(6),ZCMP(6),PHICM(6)
C
      DATA ZFRO/0.0/
      DIMENSION TTARG(50) ,NTARG(10)
      DATA TTARG/50*0.0/ , NTARG/10*0/
      DIMENSION TXARG(21), TYARG(21)
      DATA TXARG/21*0.0/,TYARG/21*0.0/
      DATA CON1/4HCONS/, VARI/4HVARI/
      DIMENSION DINCH(2),DEG(2),DIPS(2),DPS(2),PS2PI(3),PS2I(3),
     1          DIPS2(3),PIPR(3),RAPRA(2),RADS(2),RPI(2),RPI2(3),
     2          RPI3(3),PPI(2),PPI3(2),PSPI(3),RAPS(2)
      DATA DINCH/4HINCH,4HES  /,  DEG/4HDEGR,4HEES /
      DATA   DPS/4HDEG/,4HSEC /, DIPS/4HIN/S,4HEC  /
      DATA RAPRA/4HRAD/,4HRAD /, RADS/4HRADI,4HANS /
      DATA   RPI/4HRAD/,4HIN  /,   PPI/4HLB/I,4HN   /
      DATA  PPI3/4HLB/I,4HN**3/, RAPS/4HRAD/,4HSEC /
      DATA PS2PI/4HLB-S,4HEC**,4H2/IN/, PS2I/4HLB-S,4HEC**,4H2-IN/
      DATA DIPS2/4HIN/S,4HEC**,4H2   /, PIPR/4HLB-I,4HN/RA,4HD    /
      DATA  RPI2/4HRAD/,4HIN**,4H2   /, RPI3/4HRAD/,4HIN**,4H3    /
      DATA  PSPI/4HLB-S,4HEC/I,4HN   /
      DATA SEC/4HSEC /
      DIMENSION PDI(2)
      DATA PDI/4HLB-I,4HN   /,PD/4HLB  /
      DIMENSION  TD1(2),TD2(2)
      DATA UD2/4HDEL2/,UPF/4HPHIF/,UD4/4HDEL4/,UPR/4HPHIR/
      DATA UDE/4HO  =/,UVE/4HOD =/
      DIMENSION TNU2(2),TNU3(3)
      DATA TNU2/4HNOT ,4HUSED/, TNU3/4HNOT ,4HUSED,4H    /
      DIMENSION TD3(2),T3D1(3),T3D2(3)
C
   11 WRITE(6,1000) (HED(I),I=1,18),DADE(1),DADE(2),
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   1      (VHED(I),I=1,10),(THED(I),I=1,10),(CHED(I),I=1,10),
   2      (GHED(I),I=1,10),(SHED(I),I=1,10)
1000 FORMAT(1H1,9X,18A4,30X,2A4 / 5X,3(10A4) / 5X,2(10A4) / )
     WRITE(6,1001) TO,SEC,T1,SEC,DTCOMP,SEC,MODE,DTPRNT,SEC
1001 FORMAT(1H0,24X,39HP R O G R A M   C O N T R O L   D A T A  /
   1 10X,38HSTART TIME                        TO     =,F10.4,2X,A4 /
   2 10X,38HEND TIME                          T1     =,F10.4,2X,A4 /
   3 10X,38HINTEGRATION INCREMENT             DTCOMP =,F10.4,2X,A4 /
   4 62X,30H(0=VARIABLE STEP ADAMS-MOULTON    /
   5 10X,38HINTEGRATION MODE                  MODE   =,I5,
   6  8X,16H-)1= RUNGA-KUTTA    /
   7 62X,28H(2= FIXED STEP ADAMS-MOULTON   /
   8 10X,38HPRINT INTERVAL                    DTPRNT =,F10.4,2X,A4 )
     WRITE(6,1002) ISUS,INDCRB,DELTC,SEC
1002 FORMAT(1H ,
   1 61X,50H(0= INDEPENDENT FRONT SUSPENSION, SOLID REAR AXLE   /
   2 10X,38HSUSPENSION OPTION                 ISUS   =,I5,
   3  8X,42H-)1= INDEPENDENT FRONT AND REAR SUSPENSION   /
   4 62X,42H(2= SOLID FRONT AND REAR AXLES              /
   5 62X,42H(0= NO CURB, NO STEER DEGREE OF FREEDOM     /
   6 10X,38HCURB/STEER OPTION                 INDCRB =,I5,
   7  8X,10H-)1= CURB    /
   8 62X,42H(-1=STEER DEGREE OF FREEDOM, NO CURB        /
   9 10X,38HCURB INTEGRATION INCR.            DELTC  =,F10.5,2X,A4    )
     WRITE(6,1003) COMEN4
1003 FORMAT(1H ,
   A 9X,33HWHEEL SPIN EQUATION FACTOR    COMEN4 =,F10.5    )
     IF(MODE.EQ.0) WRITE(6,1008) EBAR,EM,AAA,HMAX,HMIN,BET
1008 FORMAT(1H0,9X,34HARGUMENTS FOR MODE 0 INTEGRATION : /
   A       8X,6(2X,F12.3)  )
     WRITE(6,1004) XCOP,DINCH,U0,DIPS ,YCOP,DINCH,V0,DIPS,
   A                 ZCOP,DINCH,W0,DIPS
1004 FORMAT(1H0,//,52X,38HI N I T I A L   C O N D I T I O N S   //
   1 40X, 8HXCOP   =,F8.2,3X,2A4,39X,6HU0   =,F8.2,3X,2A4        /
   2 10X,38HSPRUNG MASS C.G. POSITION     YCOP   =,F8.2,3X,2A4,
   3  7X,38HSPRUNG MASS LINEAR VELOCITY     V0   =,F8.2,3X,2A4  /
   4 40X, 8HZCOP   =,F8.2,3X,2A4,39X,6HW0   =,F8.2,3X,2A4        )
     WRITE(6,1005) PHI0,DEG,P0,DPS,THETA0,DEG,Q0,DPS,
   1                 PSI0,DEG,R0,DPS
1005 FORMAT(1H ,
   1 39X, 8HPHI0   =,F8.2,3X,2A4,39X,6HP0   =,F8.2,3X,2A4        /
   2 10X,38HSPRUNG MASS ORIENTATION       THETA0 =,F8.2,3X,2A4 ,
   3  7X,38HSPRUNG MASS ANGULAR VELOCITY    Q0   =,F8.2,3X,2A4 /
   4 40X, 8HPSI0   = F8.2,3X,2A4,39X,6HR0   =,F8.2,3X,2A4        )
     IF(ISUS.EQ.2) GO TO 101
     UMP1 = UD2
     TD1(1) = DINCH(1)
     TD1(2) = DINCH(2)
     TD2(1) = DIPS(1)
     TD2(2) = DIPS(2)
     UMP = DEL20
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      UMV = DEL20D
      GO TO 102
  101 UMP1 = UPF
      TD1(1) = DEG(1)
      TD1(2) = DEG(2)
      TD2(1) = DPS(1)
      TD2(2) = DPS(2)
      UMP = PHIFO
      UMV = PHIFOD
  102 WRITE(6,1006) DEL10,DINCH,DEL10D,DIPS,UMP1,UDE,UMP,TD1,UMP1,UVE,
     1              UMV,TD2
 1006 FORMAT(1H0,39X,8HDEL10  =,F8.2,3X,2A4,37X,8HDEL10D =,F8.2,3X,2A4/
     1 10X,30HUNSPRUNG MASS POSITIONS       ,2A4,F8.2,3X,2A4,
     2  7X,30HUNSPRUNG MASS VELOCITIES      ,2A4,F8.2,3X,2A4     )
      IF(ISUS.EQ.1) GO TO 103
      UMP1 = UPR
      TD1(1) = DEG(1)
      TD1(2) = DEG(2)
      TD2(1) = DPS(1)
      TD2(2) = DPS(2)
      UMP = PHIRO
      UMV = PHIROD
      GO TO 104
  103 UMP1 = UD4
      TD1(1) = DINCH(1)
      TD1(2) = DINCH(2)
      TD2(1) = DIPS(1)
      TD2(2) = DIPS(2)
      UMP = DEL40
      UMV = DEL40D
  104 WRITE(6,1007) DEL30,DINCH,DEL30D,DIPS,UMP1,UDE,UMP,TD1,UMP1,UVE,
     1              UMV,TD2,PSIF10,DEG,PSIFD0,DPS
 1007 FORMAT(1H ,39X,8HDEL30  =,F8.2,3X,2A4,37X,8HDEL30D =,F8.2,3X,2A4/
     1 40X,2A4,F8.2,3X,2A4,37X,2A4,F8.2,3X,2A4  /
     2 10X,38HSTEER ANGLE                      PSIFIO =,F8.2,3X,2A4,
     3  7X,38HSTEER VELOCITY                   PSIFDO =,F8.2,3X,2A4     )
      WRITE(6,1000) (HED(I),I=1,18),DADE(1),DADE(2),
     1      (VHED(I),I=1,10),(THED(I),I=1,10),(CHED(I),I=1,10),
     2      (GHED(I),I=1,10),(SHED(I),I=1,10)
      WRITE(6,2001) XMS,PS2P1,      A,DINCH,
     1              XMUF,PS2PI,     B,DINCH,
     2              XMUR,PS2PI,    ZF,DINCH
 2001 FORMAT(1H0,
     1  9X,37HSPRUNG MASS                      XMS   =,F10.3,1X,3A4,
     2  5X,32HFRONT WHEEL X LOCATION    A      =,    F10.3,1X,2A4  /
     3 10X,37HFRONT UNSPRUNG MASS              XMUF  =,F10.3,1X,3A4,
     4  5X,32HREAR WHEEL X LOCATION     B      =,    F10.3,1X,2A4  /
     5 10X,37HREAR UNSPRUNG MASS               XMUR  =,F10.3,1X,3A4,
     6  5X,32HFRONT WHEEL Z LOCATION    ZF     =,    F10.3,1X,2A4  )
      TD1(1) = TNU2(1)
      TD1(2) = TNU2(2)
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      IF(ISUS.EQ.2) GO TO 201                                           IDOT2030
      GO TO 202                                                         IDOT2040
  201 TD1(1) = DINCH(1)                                                 IDOT2050
      TD1(2) = DINCH(2)                                                 IDOT2060
  202 CONTINUE                                                          IDOT2070
      WRITE(6,2002) XIX, PS2I,     ZR  ,DINCH,                          IDOT2080
     1              XIY, PS2I,     TF  ,DINCH,                          IDOT2090
     2              XIZ, PS2I,     TR  ,DINCH,                          IDOT2100
     3              XIXZ,PS2I,    RHOF,TD1                              IDOT2110
 2002 FORMAT(1H ,                                                       IDOT2120
     1  9X,37HX MOMENT OF INERTIA                XIX   =,F10.3,1X,3A4 , IDOT2130
     2  5X,32HREAR WHEEL Z LOCATION       ZR    =,   F10.3,1X,2A4 /     IDOT2140
     3 10X,37HY MOMENT OF INERTIA                XIY   =,F10.3,1X,3A4 , IDOT2150
     4  5X,32HFRONT WHEEL TRACK           TF    =,   F10.3,1X,2A4 /     IDOT2160
     5 10X,37HZ MOMENT OF INERTIA                XIZ   =,F10.3,1X,3A4 , IDOT2170
     6  5X,32HREAR WHEEL TRACK            TR    =,   F10.3,1X,2A4 /     IDOT2180
     7 10X,37HXZ PRODUCT OF INERTIA              XIXZ  =,F10.3,1X,3A4 , IDOT2190
     8  5X,32HFRONT ROLL AXIS             RHOF =,    F10.3,1X,2A4 )     IDOT2200
      DO 203 K=1,3                                                      IDOT2210
      T3D1(K) = TNU3(K)                                                 IDOT2220
  203 T3D2(K) = TNU3(K)                                                 IDOT2230
      DO 204 K=1,2                                                      IDOT2240
      TD1(K) = TNU2(K)                                                  IDOT2250
      TD2(K) = TNU2(K)                                                  IDOT2260
  204 TD3(K) = TNU2(K)                                                  IDOT2270
      IF(ISUS.EQ.1) GO TO 206                                           IDOT2280
      DO 205 K=1,2                                                      IDOT2290
      T3D2(K) = PS2I(K)                                                 IDOT2300
      TD1(K) = DINCH(K)                                                 IDOT2310
  205 TD3(K) = DINCH(K)                                                 IDOT2320
      T3D2(3) = PS2I(3)                                                 IDOT2330
  206 IF(ISUS.NE.2) GO TO 208                                           IDOT2340
      DO 207 K=1,2                                                      IDOT2350
      T3D1(K) = PS2I(K)                                                 IDOT2360
  207 TD2(K) = DINCH(K)                                                 IDOT2370
      T3D1(3) = PS2I(3)                                                 IDOT2380
  208 WRITE(6,2003) XIF, T3D1, RHO, TD1,                                IDOT2390
     1              XIR, T3D2, TSF, TD2,                                IDOT2400
     2              G   ,DIPS2,  TS,TD3                                 IDOT2410
 2003 FORMAT(1H ,                                                       IDOT2420
     1  9X,37HFRONT AXLE MOMENT OF INERTIA  XIF   =,F10.3,1X,3A4 ,      IDOT2430
     2  5X,32HREAR ROLL AXIS              RHO   =,   F10.3,1X,2A4 /     IDOT2440
     3 10X,37HREAR AXLE MOMENT OF INERTIA   XIR   =,F10.3,1X,3A4 ,      IDOT2450
     4  5X,32HFRONT SPRING TRACK          TSF   =,   F10.3,1X,2A4 /     IDOT2460
     5 10X,37HGRAVITY                       G     =,F10.3,1X,3A4 ,      IDOT2470
     6  5X,32HREAR SPRING TRACK           TS    =,   F10.3,1X,2A4 )     IDOT2480
      DO 209 K=1,3                                                      IDOT2490
      T3D1(K) = TNU3(K)                                                 IDOT2500
      T3D2(K) = TNU3(K)                                                 IDOT2510
      IF(K.EQ.3) GO TO 209                                              IDOT2520
      TD1(K) = TNU2(K)                                                  IDOT2530
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      TD2(K) = TNU2(K)                                                  IDOT2540
      TD3(K) = TNU2(K)                                                  IDOT2550
  209 CONTINUE                                                          IDOT2560
      IF(ISUS.EQ.1) GO TO 211                                           IDOT2570
      TD1(1) = RAPRA(1)                                                 IDOT2580
      TD1(2) = RAPRA(2)                                                 IDOT2590
      GO TO 213                                                         IDOT2600
  211 DO 212 K=1,3                                                      IDOT2610
      T3D1(K) = RPI2(K)                                                 IDOT2620
      T3D2(K) = RPI3(K)                                                 IDOT2630
      IF(K.EQ.3) GO TO 212                                              IDOT2640
      TD2(K) = RADS(K)                                                  IDOT2650
      TD3(K) = RPI(K)                                                   IDOT2660
  212 CONTINUE                                                          IDOT2670
  213 WRITE(6,2004) X1,       DINCH,    RF,       PIPR,                 IDOT2680
     5                Y1,       DINCH,    RR,       PIPR,               IDOT2690
     2                Z1,       DINCH,    AKRS,     TD1,                IDOT2700
     3                X2,       DINCH,    AKDS,     TD2,                IDOT2710
     4                Y2,       DINCH,    AKDS1,    TD3,                IDOT2720
     5                Z2,       DINCH,    AKDS2,    T3D1,               IDOT2730
     6                                    AKDS3,    T3D2                IDOT2740
 2004 FORMAT(1H0,39X,7HX1     = ,F10.2,1X,2A4   ,                       IDOT2750
     1  9X,32HFRONT AUX ROLL STIFFNESS  RF   =,F10.2,1X,3A4 /           IDOT2760
     2 10X,37HACCELEROMETER 1 POSITION       Y1    =,F10.2,1X,2A4 ,     IDOT2770
     3  9X,32HREAR AUX ROLL STIFFNESS   RR   =,    F10.2,1X,3A4 /       IDOT2780
     4 40X,7HZ1    =,F10.2,1X,2A4 ,                                     IDOT2790
     5  9X,32HREAR ROLL-STEER COEF.     AKRS =,    F10.4,1X,2A4 /       IDOT2800
     6 40X,7HX2    =,F10.2,1X,2A4 ,35X,6HAKDS =,F10.3,1X,2A4     /      IDOT2810
     7 10X,37HACCELEROMETER 2 POSITION       Y2    =,F10.2,1X,2A4 ,     IDOT2820
     8  9X,32HREAR DEFL-STEER COEFS.    AKDS1=,    F10.3,1X,2A4 /       IDOT2830
     9 40X,7HZ2    =,F10.2,1X,2A4,35X,6HAKDS2=,F10.3,1X,3A4      /      IDOT2840
     A101X,6HAKDS3=,F10.3,1X,3A4  )                                     IDOT2850
      WRITE(6,2005) XIPS,PS2I,CPSP,PDI,EPSPS,RAPS,AKPS,PIPR,            IDOT2860
     1              OMGPS,RADS,XPS,DINCH                                IDOT2870
 2005 FORMAT(1H0,15X,29HS T E E R I N G   S Y S T E M      /            IDOT2880
     1 10X,31HMOMENT OF INERTIA         XIPS  =,F10.3,1X,3A4 /          IDOT2890
     2 10X,31HCOULOMB FRICTION TORQUE CPSP  =,F10.3,1X,2A4 /            IDOT2900
     3 10X,31HFRICTION LAG              EPSP  =,F10.3,1X,2A4 /          IDOT2910
     4 10X,31HANGULAR STOP RATE         AKPS  =,F10.3,1X,3A4 /          IDOT2920
     5 10X,31HANGULAR STOP POSITION     OMGPS =,F10.3,1X,2A4 /          IDOT2930
     6 10X,31HPNEUMATIC TRAIL           XPS   =,F10.3,1X,2A4 )          IDOT2940
      WRITE(6,2009) FIWJF,PS2I,FIWJR,PS2I,ARBRF,ARBRR,FIDJF,PS2I,       IDOT2950
     1              FIDJR,PS2I                                          IDOT2960
 2009 FORMAT(1H0,13X,28HD R I V E   L I N E   D A T A       /           IDOT2970
     A 10X,33HFRONT WHEEL SPIN INERTIA  FIWJF =,F8.3,1X,3A4      /      IDOT2980
     B 10X,33HREAR WHEEL SPIN INERTIA   FIWJR =,F8.3,1X,3A4      /      IDOT2990
     C 10X,33HFRONT AXLE RATIO          ARBRF =F8.3,             /      IDOT3000
     D 10X,33HREAR AXLE RATIO           ARBRR =F8.3,             /      IDOT3010
     E 10X,33HFRONT DRIVELINE INERTIA   FIDJF =,F8.3,1X,3A4      /      IDOT3020
     F 10X,33HREAD DRIVELINE INERTIA    FIDJR =,F8.3,1X,3A4      )      IDOT3030
      WRITE(6,2006) AKF,      PPI,      AKR,      PPI,                  IDOT3040
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     1                AKFC,     PPI,      AKRC,     PPI,                   IDOT3050
     2                AKFCP,    PPI3,     AKRCP,    PPI3                   IDOT3060
2006 FORMAT(1H0,36X,16HFRONT SUSPENSION,20X,15HREAR SUSPENSION  //         IDOT3070
     1 10X,41HSUSPENSION RATE                    AKF     =,F10.3,1X,2A4,   IDOT3080
     2  9X,8HAKR     =,F10.3,1X,2A4  /                                     IDOT3090
     3 10X,41HCOMPRESSION STOP COEFS.            AKFC    =,F10.3,1X,2A4,   IDOT3100
     4  9X,8HAKRC    =,F10.3,1X,2A4  /                                     IDOT3110
     5 43X,8HAKFCP   =,F10.3,1X,2A4,9X,8HAKRCP   =,F10.3,1X,2A4   )        IDOT3120
      WRITE(6,2007) AKFE,     PPI,      AKRE,     PPI,                     IDOT3130
     1                AKFEP,    PPI3,     AKREP,    PPI3,                  IDOT3140
     2                OMEGFC,   DINCH,    OMEGRC,   DINCH,                 IDOT3150
     3                OMEGFE,   DINCH,    OMEGRE,   DINCH                  IDOT3160
2007 FORMAT(1H ,                                                           IDOT3170
     1  9X,41HEXTENSION STOP COEFS.              AKFE    =,F10.3,1X,2A4,   IDOT3180
     2  9X, 8HAKRE    =,F10.3,1X,2A4  /                                    IDOT3190
     3 43X, 8HAKFEP   =,F10.3,1X,2A4,9X,8HAKREP   =,F10.3,1X,2A4  /        IDOT3200
     4 10X,41HCOMPRESSION STOP LOCATION          OMEGFC =,F10.3,1X,2A4,    IDOT3210
     5  9X, 8HOMEGRC =,F10.3,1X,2A4  /                                     IDOT3220
     6 10X,41HEXTENSION STOP LOCATION            OMEGFE =,F10.3,1X,2A4,    IDOT3230
     7  9X, 8HOMEGRE =,F10.3,1X,2A4  )                                     IDOT3240
      WRITE(6,2008) XLAMF,              XLAMR,                             IDOT3250
     1                CF,       PSPI,     CR,       PSPI,                  IDOT3260
     2                CFP,      PD,       CRP,      PD,                    IDOT3270
     3                EPSF,     DIPS,     EPSR,     DIPS                   IDOT3280
2008 FORMAT(1H ,                                                           IDOT3290
     1  9X,41HSTOP ENERGY DISSIPATION FACTOR     XLAMF  =,F10.3,           IDOT3300
     2 18X, 8HXLAMR  =,F10.3  /                                            IDOT3310
     3 10X,41HVISCOUS DAMPING COEF.              CF      =,F10.3,1X,3A4,   IDOT3320
     4  5X, 8HCR      =,F10.3,1X,3A4  /                                    IDOT3330
     5 10X,41HCOULOMB FRICTION                   CFP     =,F10.3,1X,1A4,   IDOT3340
     6 13X, 8HCRP     =,F10.3,1X,1A4  /                                    IDOT3350
     7 10X,41HFRICTION LAG                       EPSF    =,F10.3,1X,2A4,   IDOT3360
     8  9X, 8HEPSR    =,F10.3,1X,2A4  )                                    IDOT3370
      IF(ISUS.EQ.2.AND.IAPFR(1)+IAPFR(2).EQ.0) GO TO 404                   IDOT3380
      WRITE(6,1000) (HED(I),I=1,18),DADE(1),DADE(2),                       IDOT3390
     1     (VHED(I),I=1,10),(THED(I),I=1,10),(CHED(I),I=1,10),             IDOT3400
     2     (GHED(I),I=1,10),(SHED(I),I=1,10)                               IDOT3410
      IF(ISUS.EQ.2) GO TO 301                                              IDOT3420
      DO 306 K=1,2                                                         IDOT3430
      TD1(K) = DINCH(K)                                                    IDOT3440
 306  TD2(K) = DEG(K)                                                      IDOT3450
      IF(ISUS.EQ.1) GO TO 308                                              IDOT3460
      DO 307 K=1,2                                                         IDOT3470
      TD1(K) = TNU2(K)                                                     IDOT3480
 307  TD2(K) = TNU2(K)                                                     IDOT3490
 308  WRITE(6,3001) DINCH,DEG,TD1,TD2,DINCH,DINCH,TD1,TD1                  IDOT3500
3001 FORMAT(1H0,                                                           IDOT3510
     A 10X,18HFRONT WHEEL CAMBER, 8X,17HREAR WHEEL CAMBER,                 IDOT3520
     B  6X,23HFRONT HALF-TRACK CHANGE, 4X,22HREAR HALF-TRACK CHANGE  /     IDOT3530
     C 18X,2HVS,24X,2HVS,24X,2HVS,24X,2HVS  /                              IDOT3540
     D  9X,21HSUSPENSION DEFLECTION, 5X,21HSUSPENSION DEFLECTION,          IDOT3550
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     E  5X,21HSUSPENSION DEFLECTION, 5X,21HSUSPENSION DEFLECTION    //
     F 12X,15HDELTAF      PHIC,11X,16HDELTAR      PHIRC ,
     G 10X,15HDELTAF      DTHF,11X,15HDELTAR      DTHR  /
     H 12X,2A4,2X,2A4,8X,2A4,2X,2A4,8X,2A4,2X,2A4,8X,2A4,2X,2A4       )
      Y = DELB
      DO 302 I=1,NDEL
      TTARG(I) = Y
      Y = Y+DDEL
  302 CONTINUE
      WRITE(6,3002) (TTARG(I),PHIC(I),TTARG(I),PHIRC(I),
     1               TTARG(I),DTHF(I),TTARG(I),DTHR(I),I=1,NDEL)
 3002 FORMAT(1H0,4(8X,F8.2,2X,F8.2)/(1X,4(8X,F8.2,2X,F8.2))       )
  301 CONTINUE
      IF( IAPFR(1) .EQ.0 .AND. IAPFR(2) .EQ.0) GO TO 400
      WRITE(6,4004)
 4004 FORMAT(1H0,8X,48HANTI-PITCH TABLES FOR CIRCUMFERENTIAL TIRE FORCE
     1     // 9X,11HFRONT WHEEL,5X,3HAPF,5X,10HREAR WHEEL,5X,3HAPR /
     2     9X,11HDEFL. - IN.,3X,8HLB/LB-FT,5X,10HDEFL.- IN.,
     3     3X,8HLB/LB-FT  / )
      FDEF = DAPFB
      RDEF = DAPRB
      MAP = NAPF
      IF(NAPF.NE.NAPR) MAP = MINO(NAPF,NAPR)
      IF(NAPF.EQ.0) GO TO 402
      IF(NAPR.EQ.0) GO TO 406
      DO 401 I=1,MAP
      WRITE(6,4005) FDEF,APF(I),RDEF,APR(I)
 4005 FORMAT(5X,4(5X,F8.4))
      FDEF = FDEF+DDAPF
  401 RDEF = RDEF+DDAPR
      IF(NAPF.EQ.NAPR) GO TO 404
      IF(NAPR.GT.NAPF) GO TO 402
  406 MAP1 = MAP+1
      DO 403 I=MAP1,NAPF
      WRITE(6,4006) FDEF,APF(I)
 4006 FORMAT(5X,2(5X,F8.4))
  403 FDEF = FDEF+DDAPF
      GO TO 404
  402 MAP1 = MAP+1
      DO 405 I=MAP1,NAPR
      WRITE(6,4007) RDEF,APR(I)
 4007 FORMAT(31X,2(5X,F8.4))
  405 RDEF = RDEF+DDAPR
      GO TO 404
  400 WRITE(6,4008)
 4008 FORMAT(21H0NO ANTI-PITCH TABLES)
  404 CONTINUE
      IF(TINCR.EQ.0.0.AND.IDRVER.EQ.0) GO TO 408
      WRITE(6,1000) (HED(I),I=1,18),DADE(1),DADE(2),
     1     (VHED(I),I=1,10),(THED(I),I=1,10),(CHED(I),I=1,10),
     2     (GHED(I),I=1,10),(SHED(I),I=1,10)
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      NTPR = 0
      TTARG(1) = 0.0
      IF(TINCR.EQ.0.0) GO TO 304
      NTPR = (TE-TB)/TINCR + 1.5
      Y = TB
      DO 305 I=1,NTPR
      TTARG(I) = Y
      Y = Y+TINCR
  305 CONTINUE
      WRITE(6,3003)
 3003 FORMAT(1H0,//56X,21HDRIVER CONTROL TABLES  //
     1 4(32H      T      PSIF      TQF      TQR )      /
     2 4(32H    SEC      DEG     LB-FT    LB-FT)      /)
C        NTPR4 IS NUMBER OF LINES FOR TABLES IN FOUR GROUPS PER LINE
      NNADD = 0
      IF((MOD(NTPR,4)).NE.0) NNADD=1
      NTPR4 = NTPR/4 + NNADD
      NTPR43 = 3*NTPR4
      DO 303 J=1,NTPR4
      I1 = J
      I4 = MIN0(NTPR ,I1+NTPR43)
      WRITE(6,3004)((TTARG(II),PSIF(II),TQF(II),TQR(II)),II=I1,I4,NTPR4)
 3004 FORMAT(1X,4(F8.3,F8.3,F8.1,F8.1)  )
  303 CONTINUE
  304 CONTINUE
      IF(IDRVER.NE.0) CALL DRIVID
  408 CONTINUE
C
      WRITE(6,1000) (HED(I),I=1,18),DADE(1),DADE(2),
     1     (VHED(I),I=1,10),(THED(I),I=1,10),(CHED(I),I=1,10),
     2     (GHED(I),I=1,10),(SHED(I),I=1,10)
      WRITE(6,4001)
 4001 FORMAT(1H0,60X,17HT I R E   D A T A   /
     A 54X,2HRF,10X,2HLF,10X,2HRR,10X,2HLR  )
      WRITE(6,4002) AKT,PPI,SIGT,DINCH,XLAMT,A0,A1,A2,A3,A4
 4002 FORMAT(1H0,
     A  9X,39HTIRE LINEAR SPRING RATE          AKT    =,4(F10.3,2X),2A4 /
     B 10X,39HDEFL. FOR INCREASED RATE         SIGT   =,4(F10.3,2X),2A4 /
     C 10X,39HSPRING RATE INCREASING FACTOR    XLAMT  =,4(F10.3,2X)     /
     D 41X, 8HA0      =,4(F10.3,2X)  /
     E 41X, 8HA1      =,4(F10.3,2X)  /
     F 10X,39HSIDE FORCE COEFFICIENTS          A2     =,4(F10.3,2X)     /
     G 41X, 8HA3      =,4(F10.3,2X)  /
     H 41X, 8HA4      =,4(F10.3,2X)   )
      WRITE(6,4003) OMEGT,RW,DINCH,XMUM,CT,PD,RRMC,AMU(1)
 4003 FORMAT(1H ,
     I 10X,39HTIRE OVERLOAD FACTOR             OMEGT  =,4(F10.3,2X)     /
     J 10X,39HTIRE UNDEFLECTED RADIUS          RW     =,4(F10.3,2X),2A4 /
     K 10X,39HTIRE MEASUREMENT FRICTION        XMUM   =,4(F10.3,2X)     /
     P 10X,39HCIRCUM. FORCE STIFFNESS          CT     =,4(F10.3,2X),A4 /
     L 10X,39HROLLING RESISTANCE MOMENT COEF RRMC   =,4(F10.3,2X),
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     M   2X,8HLB-IN/LB   /
     N 10X,34HNOMINAL GROUND FRICTION COEF AMU =,F10.4        /)
      CALL IDOUTA(HED,DADE)
      IF(INDCRB.NE.1) GO TO 702
      WRITE(6,1000) (HED(I),I=1,18),DADE(1),DADE(2),
     1   (VHED(I),I=1,10),(THED(I),I=1,10),(CHED(I),I=1,10),
     2    (GHED(I),I=1,10),(SHED(I),I=1,10)
      WRITE(6,6010)
6010 FORMAT(1H0,22X,17HC U R B   D A T A    //
     A 10X,54HCURB SLOPE CHANGE      ELEVATION AT      CURB FACE ANGLE  /
     B 10X,34H LATERAL POSITION      SLOPE CHANGE     /
     C 18X,6HINCHES,11X,6HINCHES,11X,7HDEGREES      //  )
      WRITE(6,6011) YC1P,                      PHIC1,
     A               YC2P,      ZC2P,      PHIC2,
     B               YC3P,      ZC3P,      PHIC3,
     C               YC4P,      ZC4P,      PHIC4,
     D               YC5P,      ZC5P,      PHIC5,
     E               YC6P,      ZC6P,      PHIC6,
     F               NCRBSL,    AMUC
6011 FORMAT(1H ,
     A 11X,6HYC1P =,F9.2,23X,7HPHIC1 =,F9.2,   /
     B 12X,6HYC2P =,F9.2,3X,6HZC2P =,F9.2,5X,7HPHIC2 =,F9.2,     /
     C 12X,6HYC3P =,F9.2,3X,6HZC3P =,F9.2,5X,7HPHIC3 =,F9.2,     /
     D 12X,6HYC4P =,F9.2,3X,6HZC4P =,F9.2,5X,7HPHIC4 =,F9.2,     /
     E 12X,6HYC5P =,F9.2,3X,6HZC5P =,F9.2,5X,7HPHIC5 =,F9.2,     /
     F 12X,6HYC6P =,F9.2,3X,6HZC6P =,F9.2,5X,7HPHIC6 =,F9.2,     /
     G 12X,8HNCRBSL =,I4   /
     F 10X,43HCURB FRICTION COEFFICIENT FACTOR     AMUC  =,F8.3          )
      WRITE(6,7001) RWHJB,RWHJE,DRWHJ
7001 FORMAT(37H0WHEEL RADIUS-RADIAL SPRING FOR TABLE  /17H RWHJB(BEGIN)
     1   =,F8.3,7H INCHES / 17H RWHJE(END)       =,F8.3,5H    '' /,
     2 17H DRWHJ(INCRE.)  =,F8.3,5H    '' )
      NFJP = 0
      IF(DRWHJ.EQ.0.0) GO TO 702
      NFJP = (RWHJE-RWHJB)/DRWHJ + 1.2
      IF(NFJP.LE.0) GO TO 702
      Y = RWHJB
      DO 701 I=1,NFJP
      TTARG(I) = Y
      Y = Y + DRWHJ
 701 CONTINUE
      WRITE(6,7002)
7002 FORMAT(//1H ,3X,5HRW-HJ,6X,4HFJP.,6X,4HFJP.,6X,4HFJP.,6X,4HFJP. /
     A        5X,3HIN.,7X,4HLBS.,6X,4HLBS.,6X,4HLBS.,6X,4HLBS.   /
     B        16X,2HRF,8X,2HLF,8X,2HRR,8X,2HLR   /  )
      DO 703 J=1,NFJP
      WRITE(6,7003) TTARG(J),(FJP(J,II),II=1,4)
7003 FORMAT(1H ,G9.3,4G10.3)
 703 CONTINUE
 702 CONTINUE
      IF(NZTAB.EQ.0) GO TO 700
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      DO 601 I=1,50                                                      IDOT5090
  601 TTARG(I) = 0.0                                                     IDOT5100
      DO 602 I=1,10                                                      IDOT5110
  602 NTARG(I) = 0                                                       IDOT5120
      DO 603 I=1,NZTAB                                                   IDOT5130
      TTARG(I) =       XB(I)                                             IDOT5140
      TTARG(5 + I)= XE(I)                                                IDOT5150
      TTARG(10 + I) = XINCR(I)                                           IDOT5160
      TTARG(15 + I) = YB(I)                                              IDOT5170
      TTARG(20 + I) = YE(I)                                              IDOT5180
      TTARG(25 + I) = YINCR(I)                                           IDOT5190
      TTARG(30 + I) = AMUG(I)                                            IDOT5200
      NTARG(I)      = NBX(I)                                             IDOT5210
      NTARG(5 + I) = NBY(I)                                              IDOT5220
  603 CONTINUE                                                           IDOT5230
      WRITE(6,1000) (HED(I),I=1,18),DADE(1),DADE(2),                     IDOT5240
     1     (VHED(I),I=1,10),(THED(I),I=1,10),(CHED(I),I=1,10),           IDOT5250
     2     (GHED(I),I=1,10),(SHED(I),I=1,10)                             IDOT5260
      WRITE(6,6001)                                                      IDOT5270
 6001 FORMAT(//1H ,26X,25HTERRAIN TABLE ARGUMENTS        )               IDOT5280
      WRITE(6,6002)  (TTARG(I),I=1,5),                                   IDOT5290
     1               (TTARG(I),I=6,10),                                  IDOT5300
     2               (TTARG(I),I=11,14),ZERO,                            IDOT5310
     3               (TTARG(I),I=16,20),                                 IDOT5320
     4               (TTARG(I),I=21,25),                                 IDOT5330
     5               (TTARG(I),I=26,29),ZERO,                            IDOT5340
     6               (NTARG(I),I=1,5),                                   IDOT5350
     7               (NTARG(I),I=6,10),                                  IDOT5360
     8               (TTARG(I),I=31,35),                                 IDOT5370
     9                NZTAB                                              IDOT5380
 6002 FORMAT(1H0,25X,11H XB(BEGIN)=,5F12.3,7H INCHES   /                 IDOT5390
     A           26X,11H XE(END)  =,5F12.3,5H   ''     /                 IDOT5400
     B           26X,11H X(INCR)  =,5F12.3,5H   ''     /                 IDOT5410
     C           26X,11H YB(BEGIN)=,5F12.3,5H   ''     /                 IDOT5420
     D           26X,11H YE(END)  =,5F12.3,5H   ''     /                 IDOT5430
     E           26X,11H Y(INCR)  =,5F12.3,5H   ''     /                 IDOT5440
     F          25X,12HNO.X BOUNDS=,I8,4I12            /                 IDOT5450
     G          25X,12HNO.Y BOUNDS=,I8,4I12            /                 IDOT5460
     H           26X,11H AMUG     =,5F12.3             /                 IDOT5470
     I           25X,18HNO.TERRAIN TABLES=,I4          )                 IDOT5480
      IF(NZ5.EQ.0) GO TO 600                                             IDOT5490
      WRITE(6,1000) (HED(I),I=1,18),DADE(1),DADE(2),                     IDOT5500
     1     (VHED(I),I=1,10),(THED(I),I=1,10),(CHED(I),I=1,10),           IDOT5510
     2     (GHED(I),I=1,10),(SHED(I),I=1,10)                             IDOT5520
      NX5 = NX(NZTAB)                                                    IDOT5530
      NY5 = NY(NZTAB)                                                    IDOT5540
      WRITE(6,6004) NX5, (XXZGP5(I),I=1,NX5)                             IDOT5550
 6004 FORMAT(66H0 ARGUMENTS FOR TERRAIN TABLE WITH VARYING INCREMENTS (LIDOT5560
     1AST TABLE) /10H NO.OF X =, I3,2X,9H, X(ZGP)=, 12F9.3/24X,9F9.3)   IDOT5570
      WRITE(6,6003) NY5, (YYZGP5(I),I=1,NY5)                             IDOT5580
 6003 FORMAT(10H0NO.OF Y =, I3,2X,9H, Y(ZGP)=,12F9.3/24X, 9F9.3)        IDOT5590
```

```
C                                                                       IDOT5600
  600 IF(NZTAB) 604,700,604                                             IDOT5610
  604 WRITE(6,1000) (HED(I),I=1,18),DADE(1),DADE(2),                    IDOT5620
     1      (VHED(I),I=1,10),(THED(I),I=1,10),(CHED(I),I=1,10),         IDOT5630
     2      (GHED(I),I=1,10),(SHED(I),I=1,10)                           IDOT5640
      LINES =3                                                          IDOT5650
      DO 614 I=1,NZTAB                                                  IDOT5660
      NNBX = NBX(I)                                                     IDOT5670
      NNBY = NBY(I)                                                     IDOT5680
      NNX = NX(I)                                                       IDOT5690
      NNY = NY(I)                                                       IDOT5700
      LINES = LINES + 9 + (NNY+1)*(NNX/7 + 2)                           IDOT5710
      IF(I.EQ.1) GO TO 606                                              IDOT5720
      IF(LINES .LT.55) GO TO 606                                        IDOT5730
      WRITE(6,1000) (HED(N),N=1,18),DADE(1),DADE(2),                    IDOT5740
     1      (VHED(N),N=1,10),(THED(N),N=1,10),(CHED(N),N=1,10),         IDOT5750
     2      (GHED(N),N=1,10),(SHED(N),N=1,10)                           IDOT5760
      LINES =3                                                          IDOT5770
  606 WRITE(6,6005) I,AMUG(I),(XBDRY(J,I),J=1,NNBX)                     IDOT5780
 6005 FORMAT(19H0 TERRAIN TABLE NO. ,I3,  20X, 6H AMUG=, F13.5//        IDOT5790
     X 1X,16H  X  BOUNDARIES=,4F13.5)                                   IDOT5800
      WRITE(6,6006) (PSBDRO(J,I),J=1,NNBX)                              IDOT5810
 6006 FORMAT(1X,16H PSI BOUNDARIES=,4F13.5)                             IDOT5820
      WRITE(6,6007) (YBDRY(J,I),J=1,NNBY)                               IDOT5830
 6007 FORMAT(1X,16H  Y  BOUNDARIES=,2F13.5)                             IDOT5840
      IF( I.EQ.NZTAB .AND. NZ5.NE.0) GO TO 607                          IDOT5850
      ANAME = CONI                                                      IDOT5860
      Y= XB(I)                                                          IDOT5870
      YYY = XINCR(I)                                                    IDOT5880
      DO 605 J=1,NNX                                                    IDOT5890
      TXARG(J) = Y                                                      IDOT5900
      Y = Y + YYY                                                       IDOT5910
  605 CONTINUE                                                          IDOT5920
      Y = YB(I)                                                         IDOT5930
      YYY = YINCR(I)                                                    IDOT5940
      DO 609 J=1,NNY                                                    IDOT5950
      TYARG(J) = Y                                                      IDOT5960
      Y = Y + YYY                                                       IDOT5970
  609 CONTINUE                                                          IDOT5980
      GO TO 610                                                         IDOT5990
  607 ANAME = VARI                                                      IDOT6000
      DO 611 J=1,NNX                                                    IDOT6010
  611 TXARG(J) = XXZGP5(J)                                              IDOT6020
      DO 612 J=1,NNY                                                    IDOT6030
  612 TYARG(J) = YYZGP5(J)                                              IDOT6040
  610 WRITE(6,6008)ANAME,(TXARG(J),J=1,NNX)                             IDOT6050
 6008 FORMAT(1H0,A4,17H. INCREMENTS    X=,2X,7F13.5/26X,7F13.5/28X,7F13.5IDOT6060
     X )                                                                IDOT6070
      DO 613 II=1,NNY                                                   IDOT6080
      WRITE(6,6009) TYARG(II),(ZGP(JJ,II,I),JJ=1,NNX)                   IDOT6090
 6009 FORMAT(/2X,3H Y=,F13.5, 6X,7F13.5/26X,7F13.5/28X,7F13.5)          IDOT6100
```

```
  613 CONTINUE
  614 CONTINUE
C
  700 CONTINUE
C
      WRITE(6,9007)
 9007 FORMAT(1H1)
      RETURN
      END
```

```
      SUBROUTINE IDOUTA (HDD,DATE)
C           HVOSM-VD2 VERSION
C           REVISED OCTOBER 1975   CALSPAN CORPORATION
      COMMON/HEAD/ VHED(20),CHED(20),GHED(20),SHED(20),THED(20),
     1             NPAGE(20)
      COMMON /INPT4/ FIDJ(2),FIWJ(2),ARBR(2),NXUGMU,NXFRCP,XXUGMU(6),
     A               XXFRCP(6),XMUMAT(6,6,4),XMXPMT(6,6,4),
     B               XMXSMT(6,6,4),SLIPMT(6,6,4),CT(4),XMUM(4),
     C               XMUXP(4),XMUXS(4),RRMC(4),RRM(4),COMEN4
      EQUIVALENCE (FIDJ(1),FIDJF),(FIDJ(2),FIDJR),(FIWJ(1),FIWJF)
      EQUIVALENCE (FIWJ(2),FIWJR),(ARBR(1),ARBRF),(ARBR(2),ARBRR)
      COMMON/INPT5/ IBTYP(2),AK1,AK2,PONE,PTWO,PZERO(2),GN(16,2),ZETAB,
     1              CONE,CTWO,CTHREE,TAUA,TAUO(4),TLF(51),TTAU(51),
     2              TRPME(12),TWOT(12),TCT(12),TT(101),TPC(101),TTR(101)
     3             ,TTS(101),BTLF,ETLF,DTLF,NTLF,BRPM,ERPM,NRPM,
     4              BTT,ETT,DTT,NTT1,NTT2,NTT3,NTTS,XINPT5(9)
      DIMENSION HDD(36), DATE(3)
      DIMENSION NNN(6)
      DATA NNN/1,2,3,4,5,6/
      DATA JTO/6/
C
 1010 FORMAT(1H1,19X,18A4,20X,2A4 / 5X,3(10A4) / 5X,2(10A4) / )
      WRITE(JTO,1000)
 1000 FORMAT(1H0)
      WRITE(JTO,1040)
 1040 FORMAT(1H0,
     A 61H SPEED    | LOAD   |  LATERAL FRICTION COEF.    | PEAK LONG. FRIC
     B 61HTION COEF. | SLIDING LONG. FRICTION     | SLIP AT PEAK LONG. F
     C  7HRICT. |    / 1X,
     D 61H IN/SEC | LBS   |          XMUY              |          XMUXP
     E 61H             |  COEF.    XMUXS            |            SLIPP
     F  7H       |    / 1X,
     G 61H                      | RF      LF      RR      LR  | RF      LF
     H 61HRR      LR  | RF      LF      RR      LR  | RF      LF      RR
     I  7H  LR  |    /  )
      DO 141 I1 = 1,NXUGMU
      DO 141 I2 = 1,NXFRCP
      WRITE(JTO,1044) XXUGMU(I1),XXFRCP(I2),(XMUMAT(I2,I1,I3),I3=1,4),
     A            (XMXPMT(I2,I1,I3),I3=1,4),(XMXSMT(I2,I1,I3),I3=1,4),
     B            (SLIPMT(I2,I1,I3),I3=1,4)
 1044 FORMAT(1H ,2(F7.2,1X),16(2X,F5.3)  )
  141 CONTINUE
C
      WRITE(JTO,1010) (HDD(I),I=1,18),DATE(1),DATE(2),
     1     (VHED(I),I=1,10),(THED(I),I=1,10),(CHED(I),I=1,10),
     2     (CHED(I),I=1,10),(SHED(I),I=1,10)
      WRITE(JTO,1060) NTTS,TAUA,IBTYP(1), PZERO(1),IBTYP(2),PZERO(2),AK1
     1 ,CONE
 1060 FORMAT(1H0,35X,38H BRAKING SYSTEMS WITH COMPUTED TORQUES  ///
```

```
     140H NTTS,(MAX 101),NO.OF PC,TS,TR ENTRIES =,I10, 20X,
     240H TAUA   AMBIENT TEMPERATURE, DEG.F     =,F10.1 /
     327H IBTYP(1)  FRONT BRAKE TYPE,12X,1H=,I10,20X,
     440H PO(1)  FRONT,BRAKE PUSH OUT PRES.,PSIG=,F10.2 /
     527H IBTYP(2)  REAR    ''     '' ,12X,1H=,I10,20X,
     640H PO(2)  REAR,  ''         ''      ''      '' =, F10.2 /
     740H K1   SLOPE PR/PF (P1.LT.PF.LE.P2)      =, F10.4,20X,
     840H C1      COEFFICIENT FOR RESISTING FORCE=, 1PE12.5)
      WRITE(JTO,1062) AK2,CTWO,PONE,CTHREE,PTWO,ZETAB
 1062 FORMAT(28H K2      ''   ''   (PF.GT.P2),11X,1H=,F10.4, 20X,
     140H C2            ''              ''         '' =, 1PE12.5  /
     240H P1   BRAKE PRES. FOR PR/PF CHANGE,PSIG=,  E12.5,18X,
     340H C3            ''              ''         '' =,  E12.5  /
     440H P2       ''    ''        ''      ''      '' =,  E12.5,  10X,
     559H ZETAB,THRESHOLD WHEEL SPEED TO LIMIT BRAKE TORQUE,RAD/SEC=,
     6   OPF8.2 )
      WRITE(JTO,1000)
      WRITE(JTO,1064) BTT,ETT,DTT
 1064 FORMAT(32HO TABLES PC,TS,TR VARY WITH TIME     /
     1       17H  TT(J),J=1,NTTS,1X,F4.1,1X,2HTO,2X,F5.1,1X,
     2      8HSECS. IN,1X,F4.2,1X,14HSEC INCREMENTS  )
      WRITE(JTO,1066)
 1066 FORMAT(// 3(10X,6H BRAKE,6X,22H THROTTLE TRANSMISSION)/3(9X,11H MA
     1STER CYL,     2X,18H SETTING      RATIO, 4X )/3(4X, 4H SEC,1X, 12H
     2PRES.(PSIG),23X)/  3(5X,3H TT, 4X,3H PC,10X, 3H TS, 8X,3H TR,5X ))
      NNADD = 0
      IF(MOD(NTTS,3).NE.0) NNADD =1
      NT3 = NTTS/3 + NNADD
      NT33 = 2*NT3
      DO 165 J = 1,NT3
      I1 = J
      I3 = MINO(NTTS,I1+NT33 )
      WRITE(JTO,1068) (TT(II),TPC(II),TTS(II),TTR(II) ,II= I1,I3,NT3)
 1068 FORMAT(3(1X,F7.2, F10.0, F12.3, F10.2,4X))
  165 CONTINUE
C
      WRITE(JTO,1010) (HDD(I),I=1,18),DATE(1),DATE(2),
     1     (VHED(I),I=1,10),(THED(I),I=1,10),(CHED(I),I=1,10),
     2     (GHED(I),I=1,10),(SHED(I),I=1,10)
      WRITE(JTO,1000)
      WRITE(JTO,1070)
 1070 FORMAT( 50HOENGINE RPM        ENGINE TORQUE      ENGINE TORQUE,55X,
     1 17H BRAKE PARAMETERS / 15X,19H WIDE OPEN THROTTLE,2X,16H CLOSED T
     2HROTTLE,53X,  6H FRONT,11X,5H REAR   / 21X,6H LB-FT,13X,6H LB-FT,
     357X,8H GN(I,1),10X, 8H GN(I,2) )
      WRITE(JTO,1011)
 1011 FORMAT(1H )
      DO 170 I=1,NRPM
      WRITE(JTO,1072) TRPME(I), TWOT(I), TCT(I), I, GN(I,1), GN(I,2)
 1072 FORMAT( 1X,F10.0,8X,F10.0,  9X, F10.0,46X, I3,2X,1PE15.5,2X,E15.5)
  170 CONTINUE
```

```
      NRPM1 = NRPM+1                                                    IDTA1010
      DO 174 I=NRPM1,16                                                 IDTA1020
      WRITE(JTO,1074) I, GN(I,1), GN(I,2)                               IDTA1030
 1074 FORMAT( 94X, I3,2X, 1PE15.5,2X,E15.5)                             IDTA1040
  174 CONTINUE                                                          IDTA1050
      WRITE(JTO,1000)                                                   IDTA1060
      WRITE(JTO,1000)                                                   IDTA1070
      WRITE(JTO,1080) (NNN(I),TAUO(I),I=1,4)                            IDTA1080
 1080 FORMAT( 34H0 INITIAL BRAKE TEMPERATURE, DEG.F  /  7H  TAUO(,I2,   IDTA1090
     116H), RIGHT FRONT =, F8.2 / 7H  TAUO(,I2,16H), LEFT    ''    =,F8.2/IDTA1100
     2 7H  TAUO(, I2, 16H), RIGHT REAR  =,F8.2 / 7H  TAUO(,I2, 16H), LEFIDTA1110
     3T    ''    =, F8.2)                                               IDTA1120
      WRITE(JTO,1000)                                                   IDTA1130
      WRITE(JTO,1082) BTLF,ETLF,DTLF                                    IDTA1140
 1082 FORMAT(34H0 TABLE LF VARIES WITH TEMPERATURE   /                  IDTA1150
     1       17H TTAU(J),J=1,NTLF,1X,F4.1,10H(DEG.F) TO,1X,F6.1,        IDTA1160
     2       10H(DEG.F) IN,1X,F4.1,1X,17HDEGREE INCREMENTS    )         IDTA1170
      WRITE(JTO,1011)                                                   IDTA1180
      WRITE(JTO,1084)                                                   IDTA1190
 1084 FORMAT(1H0,48X,31H BRAKE LINING FADE COEFFICIENTS / 4(3X,5H TTAU, IDTA1200
     1 7X,3H LF,15X) / 4(3X,6H DEG.F,24X) )                             IDTA1210
      WRITE(JTO,1011)                                                   IDTA1220
      NNADD = 0                                                         IDTA1230
      IF(MOD(NTLF,4).NE.0) NNADD = 1                                    IDTA1240
      NT4 = NTLF/4 + NNADD                                              IDTA1250
      NT34 = 3*NT4                                                      IDTA1260
      DO 186 J=1,NT4                                                    IDTA1270
      I1 = J                                                            IDTA1280
      I2 = MINO(NTLF,I1+NT34)                                           IDTA1290
      WRITE(JTO,1086) (TTAU(II),TLF(II),II=I1,I2,NT4)                   IDTA1300
 1086 FORMAT(  4(1X,  F7.1, F12.4, 13X))                                IDTA1310
  186 CONTINUE                                                          IDTA1320
      RETURN                                                            IDTA1330
      END                                                               IDTA1340
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      SUBROUTINE INITEQ
C              HVOSM-VD2 VERSION
C              REVISED OCTOBER 1975   CALSPAN CORPORATION
      COMMON/INPT/PHIO,THETAO,PSIO,PO,QO,RO,XCOP,YCOP,ZCOP,UO,VO,WO,
     1          A,B,DEL10,DEL20,DEL30,PHIRO,DEL10D,DEL20D,DEL30D,
     2          PHIROD,TF,TR,ZF,ZR,RHO,AKRS,XMUR,
     3          XMS,XMUF,XIX,XIY,XIZ,XIXZ,CF,AKF,XLAMF,OMEGF,CFP,EPSF,
     4          RF,CR,AKR,XLAMR,OMEGR,CRP,EPSR,RR,TS,THMAX,DTCOMP,TO,
     5          T1,DTCMP1,DTPRNT,MODE,EBAR,EM,AAA,HMAX,HMIN,BET,G,
     6          HED(36),DADE(3),XIR,X1,Y1,Z1,X2,Y2,Z2,PHIC(50),DELB,
     7          DELE,DDEL,NDEL,PSIF(50),TQF(50),TQR(50),TB,TE,TINCR,
     8          NZTAB,NZ5,XBDRY(4,5),PSBDRY(4,5),YBDRY(2,5),NBX(5),
     9          NBY(5),NTBL1,NTBL2,NTBL3,ZGP(21,21,5)
      COMMON/INPT/XB(5),XE(5),XINCR(5),NX(5),YB(5),YE(5),YINCR(5),NY(5),
     1        XXZGP5(21),YYZGP5(21),AMUG(5),PSBDRO(4,5),UVWMIN,PQRMIN
      COMMON /COMP/SUMM,THETN,PHIN,PSIN,PI,RAD,GAM1,GAM2,GAM3,GAM4,GAM5,
     1          GAM6,GAM7,GAM8,GAM9,THETT,PHIT,PSIT,ZRO,TRO2,
     2           TFO2,TIZ,RHO2,RHOMUR,AMUF,BMUR,ZPR,TM4,RHMR2,AO2APB,
     3           BO2APB,RFTF,TSO2,RRTS,BROMUR,XMUFO2,AXMFO2,XMTFO4,
     4           XIZR,RTR,RHMR2I,XIXP,XIZP,XIXZP,XIYZP,D1PD2,D1MD2,
     5           ZRD3,ZRD3R,ZFD3R,ZFD12,TIZ2,TG61,DD1P2,DD1M2,RPR,PHRP
     6          ,TANTP,SPHTP,CPHTP,SECTP,SFXS,SFYS,SFZS,SNPS,SNTS,
     7           SNPSS,TPR,CAY,CBY,CGY,CAX,CBX,CGX,SFYU,SFXU,SFYUF,
     8           SFYUR,SFZU,COSTH,SINTH,COSPS,SINPS,COSPH,SINPH,ANG1,
     9           ANG2,CPHI,SPHI,CPSI,SPSI,P1,P7,P3,P4,P5,P6,TX,TY,TZ
      COMMON /COMP/TRH,DISTX,DISTY,DISTD,DISTS,D21,ZETA4,ZETA4D,ZETA3,
     1           ZETA3D,SFZ1,SNPU,SNTU,HCGH1,HCGH2,HCGH3,HCGH4,TERM1,
     2           TERM2,SNPSU,SNPR,HCBH1,HCBH2,HCBH3,HCBH4,HCAH1,HCAH2,
     3           HCAH3,HCAH4,UQ,WP,UR,QR,VP,PR,P2,Q2,R2,VR,WQ,PQ,PHIR2
     4          ,PHIRD2,RPHRD,GCTH,GSTH,GCTSP,GCTCP,XXX,YYY,IX,IY,XX1,
     5           XX2,YY1,YY2,THG1,THG2,PHG1,PHG2,ZZ1,ZZ2,LLL
      DIMENSION HCAH(4),HCBH(4),HCGH(4)
      EQUIVALENCE (HCAH(1),HCAH1),(HCBH(1),HCBH1),(HCGH(1),HCGH1)
      COMMON /DIMV/X1P,X2P,X3P,X4P,Y1P,Y2P,Y3P,Y4P,Z1P,Z2P,Z3P,Z4P,PHI1,
     1           PHI2,PHI3,PHI4,PSI1,PSI2,PSI3,PSI4,CAYW(4),CBYW(4),
     2           CGYW(4),ZPGI(4),THGI(4),PHGI(4),CPG(4),SPG(4),CTG(4),
     3           STG(4),CAGZ(4),CBGZ(4),CGGZ(4),D1(4),D2(4),D3(4),
     4           XLM1(4),XLM2(4),XLM3(4),AMTX(3,3),CMTX(3,4),XGPP(4),
     5           YGPP(4),ZGPP(4),DMATX(10,11),DELTA(4),CAR(4),CBR(4),
     6           CGR(4),FR(4),HI(4),FC(4),TI(4),AX(4),BX(4),CX(4),
     7           CTXG(4),UG(4),STXG(4),AY(4),BY(4),CY(4),CPYG(4),
     8           SPYG(4),VG(4),PSIIP(4),PHICI(4),CAC(4),CBC(4),CGC(4),
     9           FCXU(4),FCYU(4),FCZU(4),FS(4),CAXW(4),CBXW(4),CGXW(4)
      COMMON /DIMV/AS(4),BS(4),CS(4),CAS(4),CBS(4),CGS(4),BETP(4),
     1           BETBR(4),FSXU(4),FSYU(4),FSZU(4),FRXU(4),FRYU(4),
     2           FRZU(4),FXU(4),FYU(4),FZU(4),SI(4),F1FI(2),F1RI(2),
     3           F2FI(2),F2RI(2),CAH(4),CBH(4),CGH(4)
      DIMENSION XP(4),YP(4),ZP(4),PHII(4),PSII(4)
      EQUIVALENCE (XP(1),X1P),(YP(1),Y1P),(ZP(1),Z1P),(PHII(1),PHI1),
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```
1              (PSI1(1),PSI1)                                              INIT0500
 COMMON /COMPN/ FRSP(4),FRCP(4),ICBHIT,JCBHIT,                             INIT0510
1               DPSINT,TANPC1,TANPC2,PHIC1R,PHIC2R,AMUCMP,PHI1D,           INIT0520
2               PHI2D,LCB1(4),LCB2(4),IHIT,AJMTX(3,3),BMTX(3,3),           INIT0530
3               SFRX(4),SFRY(4),SFRZ(4),T1PSI,T2PSI,XMUGI(4)               INIT0540
 LOGICAL LCB1,LCB2                                                         INIT0550
 COMMON /INSUS/ XIF,RHOF,TSF,PHIFO,PHIFOD,DEL40,DEL40D,ISUS,               INIT0560
1               AKDS,AKDS1,AKDS2,AKDS3,PHIRC(50),DTHF(50),DTHR(50),INIT0570
2               NCAMF,NCAMR,NDTHF,NDTHR                                    INIT0580
 COMMON /TIRIN/ AKT(4),SIGT(4),XLAMT(4),A0(4),A1(4),A2(4),A3(4),           INIT0590
1               A4(4),OMEGT(4),AMU(4),RW(4),FJP(35,4),A234(4),             INIT0600
2               A12(4),OMT2A2(4),OMT2M1(4),A23(4),ITIR(4)                  INIT0610
 DATA RPD/.01745329/                                                       INIT0620
 RHF = 0.0                                                                 INIT0630
 RHR = 0.0                                                                 INIT0640
 IF(ISUS.NE.1) RHR = RHO                                                   INIT0650
 IF(ISUS.EQ.2) RHF = RHOF                                                  INIT0660
 CTHO = COS(THETAO*RPD)                                                    INIT0670
 STHO = SIN(THETAO*RPD)                                                    INIT0680
 SIR = XMS*A*G*CTHO/(A+B)                                                  INIT0690
 SIF = XMS*G*CTHO-SIR                                                      INIT0700
 DTF = (SIF/CTHO+XMUF*G)*0.5/AKT(1)                                        INIT0710
 DTR = (SIR/CTHO+XMUR*G)*0.5/AKT(3)                                        INIT0720
 SD1 = 0.5*(B*XMS*G/(A+B)-SIF)/AKF                                         INIT0730
 SD3 = 0.5*(A*XMS*G/(A+B)-SIR)/AKR                                         INIT0740
 HCG = -ZCOP                                                               INIT0750
 ZF = (HCG+A*STHO-RW(1)+DTF)/CTHO-RHF-SD1                                  INIT0760
 ZR = (HCG-B*STHO-RW(3)+DTR)/CTHO-RHR-SD3                                  INIT0770
 FR(1) = AKT(1)*DTF                                                        INIT0780
 FR(2) = FR(1)                                                             INIT0790
 FR(3) = AKT(3)*DTR                                                        INIT0800
 FR(4) = FR(3)                                                             INIT0810
 HI(1) = RW(1)-DTF                                                         INIT0820
 HI(2) = HI(1)                                                             INIT0830
 HI(3) = RW(3)-DTR                                                         INIT0840
 HI(4) = HI(3)                                                             INIT0850
 RETURN                                                                    INIT0860
 END                                                                       INIT0870
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      SUBROUTINE INPUT
C             HVOSM-VD2 VERSION
C             REVISED OCTOBER 1975   CALSPAN CORPORATION
      DIMENSION CARDIM(20),ICARD(300),DUM(18)
      DATA NBLKS/6/
      WRITE(6,1000)
 1000 FORMAT(1H1)
C          SET INPUT CARD COUNTER
      NC = 0
C        REWIND UNIT 2
      REWIND 2
C         READ A CARD
    1 READ(5,5000,END=999) (CARDIM(K),K=1,18),NSEQ,NCARD
 5000 FORMAT(18A4,2I4)
C        OUTPUT CARD IMAGE
      WRITE(2,2001) (CARDIM(K),K=1,18),NSEQ,NCARD
      WRITE(6,6000) (CARDIM(K),K=1,18),NSEQ,NCARD
 6000 FORMAT(1H ,18A4,2I4)
      IF(NCARD.GE.9999) GO TO 20
      IF(NCARD.LE.0) GO TO 90
      IF(NSEQ.GT.0) GO TO 1
      NC = NC+1
      ICARD(NC) = NCARD
      GO TO 1
   20 REWIND 2
C        TEST FOR AT LEAST ONE CARD OTHER THAN 9999
      IF(NC.LE.0) GO TO 91
C        SET COUNTER TO PROCESS ALL BLOCK NUMBERED CARDS
      IC = 1
C       DETERMINE CARD FORMAT AND TRANSFER TO PROPER CARD BLOCK
C        SUBROUTINE TO STORE DATA
   21 NBLK = ICARD(IC)/100
      NBCRD = ICARD(IC)-NBLK*100
C        FORMAT TEST
      IF(NBCRD.EQ.0) GO TO 22
C        NUMERIC INPUT
      READ(2,2000) (DUM(K),K=1,9),NSEQ,NCARD
 2000 FORMAT(9F8.0,2I4)
      GO TO 23
   22 CONTINUE
C        ALPHANUMERIC INPUT
      READ(2,2001) (DUM(K),K=1,18),NSEQ,NCARD
 2001 FORMAT(18A4,2I4)
C        BRANCH TO PROPER SUBROUTINE TO STORE INPUT
   23 IF(NBLK .LE.0) GO TO 92
      IF(NBLK.GT.NBLKS) GO TO 93
      GO TO(100,200,300,400,500,600),NBLK
C  PRINT ERROR MESSAGE HERE ?
  100 NERR = 0
```

```
      CALL BLK01(NBLK,NBCRD,NSEQ,NCARD,DUM,NERR)
C        TEST FOR ERROR
      IF(NERR.EQ.0) GO TO 30
      GO TO 94
  200 CALL BLK02(NBLK,NBCRD,NSEQ,NCARD,DUM,NERR)
      IF(NERR.EQ.0) GO TO 30
      GO TO 94
  300 NERR = 0
      CALL BLK03(NBLK,NBCRD,NSEQ,NCARD,DUM,NERR)
      IF(NERR.EQ.0) GO TO 30
      GO TO 94
  400 NERR = 0
      CALL BLK04(NBLK,NBCRD,NSEQ,NCARD,DUM,NERR)
      IF(NERR.EQ.0) GO TO 30
      GO TO 94
  500 NERR = 0
      CALL BLK05(NBLK,NBCRD,NSEQ,NCARD,DUM,NERR)
      IF(NERR.EQ.0) GO TO 30
      GO TO 94
  600 NERR = 0
      CALL BLK06(NBLK,NBCRD,NSEQ,NCARD,DUM,NERR)
      IF(NERR.EQ.0) GO TO 30
      GO TO 94
   30 CONTINUE
C        TEST IF ALL CARDS ARE READ
      IC = IC+1
      IF(IC.GT.NC) GO TO 40
C        GET NEXT CARD FROM UNIT 2
      GO TO 21
   40 CONTINUE
C        SEARCH FOR END OF DATA
      READ(2,2001) (DUM(K),K=1,18),NSEQ,NCARD
      IF(NCARD.NE.9999) GO TO 95
      GO TO 50
  999 WRITE(6,6001) NCARD
 6001 FORMAT(56H UNEXPECTED END OF FILE ENCOUNTERED IN STMT NO. 1 OF SUB
     1        34HROUTINE INPUT.  LAST CARD READ WAS  ,I4  )
      GO TO 49
   90 WRITE(6,6002)
 6002 FORMAT(56H A CARD NUMBERED LESS THAN OF EQUAL TO ZERO WAS ENCOUNTE
     1        50HRED IN SUBROUTINE INPUT.  CARD IMAGE PRINTED ABOVE  )
      GO TO 49
   91 WRITE(6,6003)
 6003 FORMAT(33H THE NUMBER OF CARDS READ IS ZERO    )
      GO TO 49
   92 WRITE(6,6004)
 6004 FORMAT(56H A BLOCK NUMBER OF LESS THAN OF EQUAL TO ZERO HAS BEEN O
     1        7HBTAINED    )
      GO TO 49
   93 WRITE(6,6005)
 6005 FORMAT(56H A BLOCK NUMBER LARGER THAN THE ALLOWED NUMBER HAS BEEN
```

```
    1        8HOBTAINED   )                                              INPT1010
     GO TO 49                                                            INPT1020
  94 WRITE(6,6006) NBLK,NBCRD,NSEQ,NCARD,NERR                            INPT1030
6006 FORMAT(56H AN ERROR HAS OCCURRED IN STORING INPUT VALUES IN ONE OFINPT1040
    1        23H THE BLKXX SUBROUTINES.     /                            INPT1050
    2        39H THE CALLING ARGUMENTS FROM INPUT ARE :   /              INPT1060
    3         7H NBLK =,I4,2X,7HNBCRD =,I4,2X,6HNSEQ =,I4,2X,7HNCARD =,  INPT1070
    4         I4,2X,6HNERR =,I4     )                                    INPT1080
     GO TO 49                                                            INPT1090
  95 WRITE(6,6007)                                                       INPT1100
6007 FORMAT(56H AN EXPECTED 9999 CARD HAS NOT BEEN ENCOUNTERED AFTER STINPT1110
    1        20H MT NO. 40 IN INPUT.     )                               INPT1120
  49 STOP                                                                INPT1130
  50 RETURN                                                              INPT1140
     END                                                                 INPT1150
```

```
      SUBROUTINE INTPR (F,IW,XMA,ALP,NM,NA,XM,AX,ANS,ERR,ND1,ND2)
C             HVOSM-VD2 VERSION
C             REVISED OCTOBER 1975   CALSPAN CORPORATION
      DIMENSION FX(3),XMA(ND1),ALP(1),F(ND1,ND2,1)
C         NOTE VARIABLE DIMENSIONS
      REAL INTERF
       INTERF(X,X1,X2,Y1,Y2) = Y2 - (X2-X)*(Y2-Y1)/(X2-X1)
      ERR=0.0
       NA1=NA
    1  XX = AX
        X = XM
       NM1 = NM
       DO 8 I=2,NM1
       IF(XMA(I) - X) 8,6,6
    6  I1=I
       GO TO 10
    8  CONTINUE
       I1=NM1
   10 IF( XMA(I1-1)-XMA(I1))21,20,21
   20 ERR=1.0
      GO TO 23
   21 DO 14  I=2,NA1
       IF(ALP(I)-XX) 14,12,12
   12  J1=I
       GO TO 16
   14  CONTINUE
       J1=NA1
   16  JJ=J1-2
      IF( ALP(J1-1) -ALP(J1))22,20,22
   22 DO  19  L=1,2
       J=JJ+ L
   19  FX(L) = INTERF(X,XMA(I1-1),XMA(I1),F(I1-1,J,IW),F(I1,J,IW))
       FX(3) = INTERF(XX,ALP(J1-1),ALP(J1),FX(1),FX(2))
       ANS = FX(3)
   23 RETURN
      END
```

```
      SUBROUTINE INTRPL(TABLE,XMIN,XMAX,DX,X,Y)                         INTR0010
C             HVOSM-VD2 VERSION                                         INTR0020
C             REVISED OCTOBER 1975   CALSPAN CORPORATION                INTR0030
C     QUADRATIC INTERPOLATION SUBROUTINE INTRPL,ADDITIONAL ENTRY INTRPC INTR0040
      DIMENSION TABLE(1)                                                INTR0050
      ENTRY INTRPC(TABLE,XMIN,XMAX,DX,X,Y,SLOPE)                        INTR0060
    1 XLK = AMIN1(X,XMAX)                                               INTR0070
      XLK = AMAX1(XLK,XMIN)                                             INTR0080
      N1 = (XLK-XMIN)/DX+1.2                                            INTR0090
      N2 = N1+1                                                         INTR0100
      NT = (XMAX-XMIN)/DX+1.2                                           INTR0110
      NO = N1-1                                                         INTR0120
    2 IF(NO.GT.0) GO TO 3                                               INTR0130
      NO = N1                                                           INTR0140
      N1 = N2                                                           INTR0150
      N2 = N1+1                                                         INTR0160
    3 IF(N2.LE.NT) GO TO 4                                              INTR0170
      N2 = N1                                                           INTR0180
      N1 = NO                                                           INTR0190
      NO = N1-1                                                         INTR0200
    4 XXX = FLOAT(NO)*DX+XMIN                                           INTR0210
      DX2 = DX**2                                                       INTR0220
      A = (TABLE(N2)-2.0*TABLE(N1)+TABLE(NO))/(2.0*DX2)                 INTR0230
      B = (TABLE(N1)-TABLE(NO))/DX-A*(2.0*XXX-DX)                       INTR0240
      C = TABLE(N1)-(A*XXX**2+B*XXX)                                    INTR0250
      Y = (A*XLK+B)*XLK+C                                               INTR0260
      SLOPE = 2.0 * A * XLK + B                                         INTR0270
      RETURN                                                            INTR0280
      END                                                               INTR0290
```

```
      SUBROUTINE INTRP5(INDX)                                           INT50010
C              HVOSM-VD2 VERSION                                        INT50020
C              REVISED OCTOBER 1975   CALSPAN CORPORATION               INT50030
      COMMON/INPT/PHIO,THETAO,PSIO,PO,QO,RO,XCOP,YCOP,ZCOP,UO,VO,WO,    INT50040
     1          A,B,DEL10,DEL20,DEL30,PHIRO,DEL10D,DEL20D,DEL30D,       INT50050
     2          PHIROD,TF,TR,ZF,ZR,RHO,AKRS,XMUR,                       INT50060
     3          XMS,XMUF,XIX,XIY,XIZ,XIXZ,CF,AKF,XLAMF,OMEGF,CFP,EPSF,  INT50070
     4          RF,CR,AKR,XLAMR,OMEGR,CRP,EPSR,RR,TS,THMAX,DTCOMP,TO,   INT50080
     5          T1,DTCMP1,DTPRNT,MODE,EBAR,EM,AAA,HMAX,HMIN,BET,G,      INT50090
     6          HED(36),DADE(3),XIR,X1,Y1,Z1,X2,Y2,Z2,PHIC(50),DELB,    INT50100
     7          DELE,DDEL,NDEL,PSIF(50),TQF(50),TQR(50),TB,TE,TINCR,    INT50110
     8          NZTAB,NZ5,XBDRY(4,5),PSBDRY(4,5),YBDRY(2,5),NBX(5),     INT50120
     9          NBY(5),NTBL1,NTBL2,NTBL3,ZGP(21,21,5)                   INT50130
      COMMON/INPT/XB(5),XE(5),XINCR(5),NX(5),YB(5),YE(5),YINCR(5),NY(5),INT50140
     1        XXZGP5(21),YYZGP5(21),AMUG(5),PSBDRO(4,5),UVWMIN,PQRMIN   INT50150
      COMMON /DIMV/X1P,X2P,X3P,X4P,Y1P,Y2P,Y3P,Y4P,Z1P,Z2P,Z3P,Z4P,PHI1,INT50160
     1          PHI2,PHI3,PHI4,PSI1,PSI2,PSI3,PSI4,CAYW(4),CBYW(4),     INT50170
     2          CGYW(4),ZPGI(4),THGI(4),PHGI(4),CPG(4),SPG(4),CTG(4),   INT50180
     3          STG(4),CAGZ(4),CBGZ(4),CGGZ(4),D1(4),D2(4),D3(4),       INT50190
     4          XLM1(4),XLM2(4),XLM3(4),AMTX(3,3),CMTX(3,4),XGPP(4),    INT50200
     5          YGPP(4),ZGPP(4),DMATX(10,11),DELTA(4),CAR(4),CBR(4),    INT50210
     6          CGR(4),FR(4),HI(4),FC(4),TI(4),AX(4),BX(4),CX(4),       INT50220
     7          CTXG(4),UG(4),STXG(4),AY(4),BY(4),CY(4),CPYG(4),        INT50230
     8          SPYG(4),VG(4),PSIIP(4),PHICI(4),CAC(4),CBC(4),CGC(4),   INT50240
     9          FCXU(4),FCYU(4),FCZU(4),FS(4),CAXW(4),CBXW(4),CGXW(4)   INT50250
      COMMON /DIMV/AS(4),BS(4),CS(4),CAS(4),CBS(4),CGS(4),BETP(4),      INT50260
     1          BETBR(4),FSXU(4),FSYU(4),FSZU(4),FRXU(4),FRYU(4),       INT50270
     2          FRZU(4),FXU(4),FYU(4),FZU(4),SI(4),F1FI(2),F1RI(2),     INT50280
     3          F2FI(2),F2RI(2),CAH(4),CBH(4),CGH(4)                    INT50290
      DIMENSION XP(4),YP(4),ZP(4),PHII(4),PSII(4)                       INT50300
      EQUIVALENCE (XP(1),X1P),(YP(1),Y1P),(ZP(1),Z1P),(PHII(1),PHI1),   INT50310
     1          (PSII(1),PSI1)                                          INT50320
      COMMON /COMP/SUMM,THETN,PHIN,PSIN,PI,RAD,GAM1,GAM2,GAM3,GAM4,GAM5,INT50330
     1          GAM6,GAM7,GAM8,GAM9,THETT,PHIT,PSIT,ZRO,TRO2,           INT50340
     2          TFO2,TI2,RHO2,RHOMUR,AMUF,BMUR,ZPR,TM4,RHMR2,AO2APB,    INT50350
     3          BO2APB,RFTF,TSO2,RRTS,BROMUR,XMUFO2,AXMFO2,XMTFO4,      INT50360
     4          XIZR,RTR,RHMR2I,XIXP,XIZP,XIXZP,XIYZP,D1PD2,D1MD2,      INT50370
     5          ZRO3,ZRO3R,ZFD3R,ZFD12,TIZ2,TG61,DD1P2,DD1M2,RPR,PHRP   INT50380
     6         ,TANTP,SPHTP,CPHTP,SECTP,SFXS,SFYS,SFZS,SNPS,SNTS,       INT50390
     7          SNPSS,TPR,CAY,CBY,CGY,CAX,CBX,CGX,SFYU,SFXU,SFYUF,      INT50400
     8          SFYUR,SFZU,COSTH,SINTH,COSPS,SINPS,COSPH,SINPH,ANG1,    INT50410
     9          ANG2,CPHI,SPHI,CPSI,SPSI,P1,P7,P3,P4,P5,P6,TX,TY,TZ     INT50420
      COMMON /COMP/TRH,DISTX,DISTY,DISTD,DISTS,D21,ZETA4,ZETA4D,ZETA3,  INT50430
     1          ZETA3D,SFZ1,SNPU,SNTU,HCGH1,HCGH2,HCGH3,HCGH4,TERM1,    INT50440
     2          TERM2,SNPSU,SNPR,HCBH1,HCBH2,HCBH3,HCBH4,HCAH1,HCAH2,   INT50450
     3          HCAH3,HCAH4,UQ,WP,UR,QR,VP,PR,P2,Q2,R2,VR,WQ,PQ,PHIR2   INT50460
     4         ,PHIRD2,RPHRD,GCTH,GSTH,GCTSP,GCTCP,XXX,YYY,IX,IY,XX1,   INT50470
     5          XX2,YY1,YY2,THG1,THG2,PHG1,PHG2,ZZ1,ZZ2,LLL             INT50480
      DIMENSION HCAH(4),HCBH(4),HCGH(4)                                 INT50490
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      EQUIVALENCE (HCAH(1),HCAH1),(HCBH(1),HCBH1),(HCGH(1),HCGH1)       INT50500
      COMMON /COMPN/ FRSP(4),FRCP(4),ICBHIT,JCBHIT,                     INT50510
     1              DPSINT,TANPC1,TANPC2,PHIC1R,PHIC2R,AMUCMP,PHI1D,    INT50520
     2              PHI2D,LCB1(4),LCB2(4),IHIT,AJMTX(3,3),BMTX(3,3),    INT50530
     3              SFRX(4),SFRY(4),SFRZ(4),T1PSI,T2PSI,XMUGI(4)        INT50540
      LOGICAL LCB1,LCB2                                                 INT50550
      COMMON /TIRIN/ AKT(4),SIGT(4),XLAMT(4),A0(4),A1(4),A2(4),A3(4),   INT50560
     1              A4(4),OMEGT(4),AMU(4),RW(4),FJP(35,4),A234(4),      INT50570
     2              A12(4),OMT2A2(4),OMT2M1(4),A23(4),ITIR(4)           INT50580
C                                                                       INT50590
C     NWHEEL = INDX                                                     INT50600
C     IXBDRY = 0                                                        INT50610
C     IYBDRY = 0                                                        INT50620
C     XLCEPT=0.0                                                        INT50630
C     XRCEPT=0.0                                                        INT50640
C     I5 = 0                                                            INT50650
C                                                                       INT50660
      ERR = 0.0                                                         INT50670
   10 XXX = XP(INDX)                                                    INT50680
      YYY = YP(INDX)                                                    INT50690
      IT = 0                                                            INT50700
      DO 11 I=1,NZTAB                                                   INT50710
      IF( XB(I).EQ.XE(I) .OR. YB(I).EQ.YE(I)) GO TO 11                  INT50720
      IF(XXX.GE.XB(I).AND.XXX.LE.XE(I).AND.YYY.GE.YB(I).AND.YYY.LE.YE(I)INT50730
     X ) IT =I                                                          INT50740
   11 CONTINUE                                                          INT50750
      IF(IT.NE.0) GO TO 15                                              INT50760
   13 ZPGI(INDX)= 0.0                                                   INT50770
      THGI(INDX)= 0.0                                                   INT50780
      PHGI(INDX)= 0.0                                                   INT50790
      XMUGI(INDX) = AMU(INDX)                                           INT50800
      RETURN                                                            INT50810
C                ITV = 1 IDENTIFIES THE VARIABLE INCREMENT TABLE HERE.  INT50820
   15 ITV = 0                                                           INT50830
      IF( IT.EQ. NZTAB .AND. NZ5.NE.0) ITV = 1                          INT50840
      XMUGI(INDX) = AMUG(IT)*AMU(INDX)                                  INT50850
      XBT = XB(IT)                                                      INT50860
      XET = XE(IT)                                                      INT50870
      YBT = YB(IT)                                                      INT50880
      NXT = NX(IT)                                                      INT50890
      NYT = NY(IT)                                                      INT50900
      NBXT= NBX(IT)                                                     INT50910
      NBYT= NBY(IT)                                                     INT50920
      IF(ITV.GE.1) GO TO 20                                             INT50930
C       TABLES WITH CONSTANT INCREMENT                                  INT50940
      XINCRT  =  XINCR(IT)                                              INT50950
      YINCRT  =  YINCR(IT)                                              INT50960
      IX =(XXX-XBT)/XINCRT + 1.0                                        INT50970
      IY =(YYY-YBT)/YINCRT + 1.0                                        INT50980
      XX1 = XBT + FLOAT(IX-1)*XINCRT                                    INT50990
      XX2 = XX1 + XINCRT                                                INT51000
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      YY1 = YBT + FLOAT(IY-1)*YINCRT
      YY3 = YY1 + YINCRT
      GO TO 40
C       IX IS LOW INDEX FOR X , IY IS LOW INDEX FOR Y
C       FLOAT(IX-1) IS   COUNT   OF INCREMENTS
C       VARIABLE INCREMENT TABLE (ARGUMENTS GIVEN, XXZPG5(21),YYZPG5(21)
   20 DO 22 I=2,NXT
      IF (XXZGP5(I) - XXX) 22,21,21
   21 IXX = I
      GO TO 25
   22 CONTINUE
      IXX = NXT
   25 IX = IXX-1
      IF (XXZGP5(IX) -XXZGP5(IXX)) 27,26,27
   26 ERR = 1.0
      GO TO 13
   27 DO 29 I=2,NYT
      IF (YYZGP5(I) - YYY) 29,28,28
   28 IYY= I
      GO TO 30
   29 CONTINUE
      IYY= NYT
   30 IY = IYY - 1
      IF(YYZGP5(IY)    - YYZGP5(IYY))35,26,35
   35 XX1 = XXZGP5(IX)
      XX2 = XXZGP5(IXX)
      YY1 = YYZGP5(IY)
      YY3 = YYZGP5(IYY)
      XINCRT = XX2 - XX1
      YINCRT = YY3 - YY1
   40 XX3 = XX1
      XX4 = XX2
C       SEARCH FOR Y BOUNDARIES IN THIS MESH.  Y BOUNDARIES HAVE CONSTAN
      IF (NBYT .EQ. 0) GO TO 54
      JJ = 0
      DO 41 I= 1,NBYT
      IF(YY1.GE.YBDRY(I,IT).OR. YBDRY(I,IT).GT.YY3) GO TO 41
      JJ = I
C
C     IYBDRY = I
C
      GO TO 42
   41 CONTINUE
   42 IF(JJ.EQ.0) GO TO 54
      IF(YYY.GE.YBDRY(JJ,IT))GO TO 50
      YY3 = YY1
      IF(ITV.GE.1) GO TO 44
   43 YY1 = YY3 - YINCRT
      IY = IY -1
      GO TO 54
   44 YY1 = YYZGP5(IY-1)
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```
      IY = IY-1
      YINCRT = YY3 - YY1
      GO TO 54
   50 YY1 = YY3
      IF(ITV.GE.1) GO TO 52
   51 YY3 = YY1 + YINCRT
      IY = IY + 1
      GO TO 54
   52 YY3 = YYZGP5(IY +2)
      IY = IY + 1
      YINCRT =  YY3 - YY1
   54 YY2 = YY1
      YY4 = YY3
C       SEARCH FOR SLANTED BOUNDARIES
      IF (NBXT .EQ. 0) GO TO 61
      II = 0
      DO 60 I=1,NBXT
      XBDRT = XBDRY(I,IT)
C             PI AND 2.*PI ARE SINGULARITIES FOR COTAN
      IF( AMOD(PSBDRY(I,IT) , PI)  .EQ. 0.0) GO TO 60
      CTNPSB = COTAN(PSBDRY(I,IT))
      XLCEPT =  XBDRT + (YY1-YBT)*CTNPSB
      XRCEPT =  XBDRT + (YY3-YBT)*CTNPSB
      II= I
      IF( XX1.LE.XLCEPT .AND. XLCEPT.LE.XX2) GO TO 80
      IF(XLCEPT.LE.XX1 .AND. XRCEPT.GT.XX3) GO TO 80
      IF(XLCEPT.GE.XX2 .AND. XRCEPT.LT.XX4) GO TO 80
   60 CONTINUE
C       NO SLANT BOUNDARY IN THIS MESH
   61 XXMXX1 = XXX-XX1
      YYMYY1 = YYY-YY1
      ZPG1 = ZGP(IX ,IY ,IT)
      ZPG2 = ZGP(IX+1 ,IY ,IT)
      ZPG3 = ZGP(IX ,IY+1 ,IT)
      ZPG4 = ZGP(IX +1,IY+1 ,IT)
      ZZ1 =  ZPG1 + XXMXX1* (ZPG2-ZPG1)/XINCRT
      ZZ2 =  ZPG3 + XXMXX1* (ZPG4-ZPG3)/XINCRT
      ZPGI(INDX) = ZZ1 + YYMYY1*(ZZ2-ZZ1)/YINCRT
      THG1 = ATAN2 ((ZPG1-ZPG2),XINCRT)
      THG3 = ATAN2 ((ZPG3-ZPG4),XINCRT)
      THGI(INDX) =  THG1 + YYMYY1 *(THG3- THG1)/YINCRT
      IF(YYMYY1) 62,65,63
   62 ZPH1 = ZZ1
      ZYINCR =    -YYMYY1
      GO TO 67
   63 IF( YY3- YYY) 65,64,65
   64 PHGI(INDX) = ATAN2( (ZZ2 - ZZ1)/YINCRT, COS(THG1))
C     NOTE THG1, AS ROLL REFERENCE IS TO POINT 1 HERE
      GO TO 68
   65 ZPH1 = ZZ2
      ZYINCR =      YY3 - YYY
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   67 PHGI(INDX) = ATAN2( (ZPH1-ZPGI(INDX))/ZYINCR, COS(THGI(INDX)))
   68 RETURN
C  68 ZPGI10 = ZPGI(INDX)
C     THGI10 = THGI(INDX)/RAD
C     PHGI10 = PHGI(INDX)/RAD
C3000 RETURN
C        SLANT BOUNDARY IN THIS MESH
   80 ZXINCR = XINCRT
C
C     IXBDRY = II
C
      IF( XXX .GT.(XBDRT + (YYY - YBT)* CTNPSB) ) GO TO 140
C
C       WHEEL HAS NOT CROSSED THE SLANT BOUNDARY, STEP BACK ON X ,PERHAP
C     INDEX FOR HIGH GRID X IS IX+1, (XX2 AT IX+1,IY),(XX4 AT IX+1,IY+1)
C        COUNT OF CONSTANT INCREMENTS FOR XX2 IS IX
      NXW = IX
      IF(ITV.GE.1) GO TO 93
   83 XX2W = XX2 + XINCRT
      DO 85 I=1,NXW
      XX2W = XX2W - XINCRT
      IF( XX2W .GE. XLCEPT) GO TO 85
      IX2W= IX +2 - 1
      GO TO 90
   85 CONTINUE
      IX2W = 2
      XX2W = XBT+ XINCRT
   90 XX1 = XX2W - XINCRT
      XX4W = XX4 + XINCRT
      DO 92  I=1,NXW
      XX4W = XX4W- XINCRT
      IF(XX4W .GE. XRCEPT) GO TO 92
      IX4W = IX  +2 - 1
      GO TO  100
   92 CONTINUE
      IX4W = 2
      XX4W = XBT+ XINCRT
      GO TO 100
   93 NXW5 = IX
      NXWW = IX +2
      DO 95  I= 1,NXW5
      IX2W = NXWW - I
      IF( XXZGP5(IX2W) .LT. XLCEPT) GO TO 96
   95 CONTINUE
      IX2W = 2
   96 XX2W = XXZGP5(IX2W)
      XX1    = XXZGP5(IX2W-1)
      XINCRT =  XX2W - XX1
      DO 97  I= 1,NXW5
      IX4W = NXWW - I
      IF(XXZGP5(IX4W) .LT. XRCEPT) GO TO 98
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   97 CONTINUE                                                         INT52540
      IX4W =2                                                          INT52550
   98 XX4W = XXZGP5(IX4W)                                              INT52560
  100 IX1W = IX2W -1                                                   INT52570
      IX3W = IX4W -1                                                   INT52580
      IF(IX1W  -   IX3W) 104,103,104                                   INT52590
  103 IX = IX1W                                                        INT52600
      GO TO 61                                                         INT52610
  104 ZPG1 = ZGP(IX1W, IY, IT)                                         INT52620
      ZPG2 = ZGP(IX2W, IY, IT)                                         INT52630
      ZPG3 = ZGP(IX3W, IY+1, IT)                                       INT52640
      ZPG4 = ZGP(IX4W, IY+1, IT)                                       INT52650
      IF(IX2W - IX3W) 106,107,110                                      INT52660
  106 ZPH1  =  ZGP(IX3W-1 ,IY+1, IT)                                   INT52670
C          ZPH1 IS POINT FIVE HERE                                     INT52680
      GO TO 108                                                        INT52690
  107 ZPH1   = ZPG3                                                    INT52700
  108 ZPH2   = ZPG2                                                    INT52710
      ZTH1   = ZPG3                                                    INT52720
      ZTH2   = ZPG4                                                    INT52730
      IF(ITV.GE.1)ZXINCR = XXZGP5(IX4W) - XXZGP5(IX3W)                 INT52740
      GO TO 115                                                        INT52750
  110 IF(IX1W - IX4W) 115,112,111                                      INT52760
  111 I5 =MAX0(IX1W-1 ,1)                                              INT52770
C         ZPH2  IS POINT FIVE HERE                                     INT52780
      ZPH2    = ZGP(I5, IY,IT)                                         INT52790
      GO TO 113                                                        INT52800
  112 ZPH2    = ZPG1                                                   INT52810
  113 ZPH1    = ZPG4                                                   INT52820
      ZTH1    = ZPG1                                                   INT52830
      ZTH2    = ZPG2                                                   INT52840
      IF(ITV.GE.1)ZXINCR = XXZGP5(IX2W) - XXZGP5(IX1W)                 INT52850
  115 ZZZ1  =  ZPG2                                                    INT52860
      XXMXX1 = XXX - XX2W                                              INT52870
      YYMYY1 = YYY - YY2                                               INT52880
      GO TO 180                                                        INT52890
C          WHEEL HAS CROSSED SLANT BOUNDARY. STEP AHEAD ON X, PERHAPS. INT52900
  140 NXW = NXT -1                                                     INT52910
      KXW = IX                                                         INT52920
      IF(ITV.GE.1) GO TO 153                                           INT52930
  143 XX1W = XX1- XINCRT                                               INT52940
      DO 145 I = KXW,NXW                                               INT52950
      XX1W = XX1W + XINCRT                                             INT52960
      IF(XX1W .LT. XLCEPT) GO TO 145                                   INT52970
      IX1W = I                                                         INT52980
      GO TO 150                                                        INT52990
  145 CONTINUE                                                         INT53000
      XX1W = XET- XINCRT                                               INT53010
      IX1W = NXW                                                       INT53020
  150 XX1 = XX1W                                                       INT53030
      XX3W = XX3 - XINCRT                                              INT53040
```

```
      DO 152 I= KXW ,NXW
      XX3W = XX3W + XINCRT
      IF(XX3W .LT. XRCEPT) GO TO 152
      IX3W = I
      GO TO 160
  152 CONTINUE
      IX3W = NXW
      XX3W = XET- XINCRT
      GO TO 160
  153 DO 155  I = KXW, NXW
      IF(XXZGP5(I) .LT. XLCEPT) GO TO 155
      IX1W = I
      GO TO 156
  155 CONTINUE
      IX1W = NXW
  156 XX1W = XXZGP5(IX1W)
      XX1  = XX1W
      XINCRT =  XXZGP5(IX1W + 1) - XX1
      DO 157 I= KXW ,NXW
      IF(XXZGP5(I) .LT. XRCEPT) GO TO 157
      IX3W = I
      GO TO 158
  157 CONTINUE
      IX3W = NXW
  158 XX3W = XXZGP5(IX3W)
  160 IX2W = IX1W + 1
      IX4W = IX3W + 1
      IF(IX1W - IX3W) 164,163,164
  163 IX = IX1W
      GO TO 61
  164 ZPG1 = ZGP(IX1W,IY,IT)
      ZPG2 = ZGP(IX2W,IY,IT)
      ZPG3 = ZGP(IX3W,IY+1,IT)
      ZPG4 = ZGP(IX4W,IY+1,IT)
      IF(IX2W - IX3W) 166,167,170
  166 ZPH2 = ZGP( IX2W+1,IY,IT)
C        ZPH2 IS POINT FIVE HERE
      GO TO 168
  167 ZPH2 = ZPG2
  168 ZPH1 = ZPG3
      ZTH1 = ZPG1
      ZTH2 = ZPG2
      IF(ITV.GE.1)ZXINCR = XXZGP5(IX2W) -XXZGP5(IX1W)
      GO TO 175
  170 IF(IX1W - IX4W) 175,172,171
  171 I5 = MIN0(IX4W+1,NXT)
C        ZPH1 IS POINT FIVE HERE
      ZPH1 = ZGP(I5,IY+1,IT)
      GO TO 173
  172 ZPH1 = ZPG4
  173 ZPH2 = ZPG1
```

```
      ZTH1 = ZPG3
      ZTH2 = ZPG4
      IF(ITV.GE.1)ZXINCR= XXZGP5(IX4W) - XXZGP5(IX3W)
  175 ZZZ1 = ZPG1
      XXMXX1 = XXX - XX1
      YYMYY1 = YYY - YY1
  180 ZTH12 =  ZTH1-ZTH2
      TTANTH =  ZTH12/ZXINCR
      THGI(INDX) = ATAN2( ZTH12    , ZXINCR)
      TCOSTH = COS(THGI(INDX))
      PFAC = (ZPH1 - ZPH2)/YINCRT
      PHGI(INDX) = ATAN2( PFAC, TCOSTH)
      IF(TCOSTH) 186,185,186
  185 TTANPH = 0.0
      GO TO 187
  186 TTANPH =  PFAC/TCOSTH
  187 ZPGI(INDX) = ZZZ1 + YYMYY1*TCOSTH*TTANPH - XXMXX1* TTANTH
      RETURN
      END
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      SUBROUTINE MATRIX
C              HVOSM-VD2 VERSION
C              REVISED OCTOBER 1975   CALSPAN CORPORATION
      COMMON/INPT/PHIO,THETAO,PSIO,PO,QO,RO,XCOP,YCOP,ZCOP,UO,VO,WO,
     1            A,B,DEL10,DEL20,DEL30,PHIRO,DEL10D,DEL20D,DEL30D,
     2            PHIROD,TF,TR,ZF,ZR,RHO,AKRS,XMUR,
     3            XMS,XMUF,XIX,XIY,XIZ,XIXZ,CF,AKF,XLAMF,OMEGF,CFP,EPSF,
     4            RF,CR,AKR,XLAMR,OMEGR,CRP,EPSR,RR,TS,THMAX,DTCOMP,TO,
     5            T1,DTCMP1,DTPRNT,MODE,EBAR,EM,AAA,HMAX,HMIN,BET,G,
     6            HED(36),DADE(3),XIR,X1,Y1,Z1,X2,Y2,Z2,PHIC(50),DELB,
     7            DELE,DDEL,NDEL,PSIF(50),TQF(50),TQR(50),TB,TE,TINCR,
     8            NZTAB,NZ5,XBDRY(4,5),PSBDRY(4,5),YBDRY(2,5),NBX(5),
     9            NBY(5),NTBL1,NTBL2,NTBL3,ZGP(21,21,5)
      COMMON/INPT/XB(5),XE(5),XINCR(5),NX(5),YB(5),YE(5),YINCR(5),NY(5),
     1          XXZGP5(21),YYZGP5(21),AMUG(5),PSBDRO(4,5),UVWMIN,PQRMIN
      COMMON /INTG/NEQ,T,DT,VAR(50),DER(50)
      EQUIVALENCE (U,VAR(1)),(V,VAR(2)),(W,VAR(3)),(P,VAR(4)),(Q,VAR(5))
     1          ,(R,VAR(6)),(DEL1,VAR(7)),(DEL1D,VAR(8)),(DEL2,VAR(9)),
     2            (DEL2D,VAR(10)),(DEL3,VAR(11)),(DEL3D,VAR(12)),
     3            (PHIR,VAR(13)),(PHIRD,VAR(14)),(THETTP,VAR(15)),
     4            (PHITP,VAR(16)),(PSITP,VAR(17)),(XCP,VAR(18)),
     5            (YCP,VAR(19)),(ZCP,VAR(20)),(PSIFI,VAR(21)),
     6            (PSIFID,VAR(22))
      EQUIVALENCE (DU,DER(1)),(DV,DER(2)),(DW,DER(3)),(DP,DER(4)),
     1            (DQ,DER(5)),(DR,DER(6)),(DDEL1,DER(7)),(DDEL1D,DER(8))
     2          ,(DDEL2,DER(9)),(DDEL2D,DER(10)),(DDEL3,DER(11)),
     3            (DDEL3D,DER(12)),(DPHIR,DER(13)),(DPHIRD,DER(14)),
     4            (DTHTTP,DER(15)),(DPHITP,DER(16)),(DPSITP,DER(17)),
     5            (DXCP,DER(18)),(DYCP,DER(19)),(DZCP,DER(20)),
     6            (DPSIFI,DER(21)),(DDPSFI,DER(22))
      EQUIVALENCE (VAR(9),PHIF),(VAR(10),PHIFD),(DER(9),DPHIF),
     1            (DER(10),DPHIFD)
      EQUIVALENCE (VAR(13),DEL4),(VAR(14),DEL4D),(DER(13),DDEL4),
     1            (DER(14),DDEL4D)
      COMMON /DIMV/X1P,X2P,X3P,X4P,Y1P,Y2P,Y3P,Y4P,Z1P,Z2P,Z3P,Z4P,PHI1,
     1              PHI2,PHI3,PHI4,PSI1,PSI2,PSI3,PSI4,CAYW(4),CBYW(4),
     2              CGYW(4),ZPGI(4),THGI(4),PHGI(4),CPG(4),SPG(4),CTG(4),
     3              STG(4),CAGZ(4),CBGZ(4),CGGZ(4),D1(4),D2(4),D3(4),
     4              XLM1(4),XLM2(4),XLM3(4),AMTX(3,3),CMTX(3,4),XCPP(4),
     5              YGPP(4),ZGPP(4),DMATX(10,11),DELTA(4),CAR(4),CBR(4),
     6              CGR(4),FR(4),HI(4),FC(4),TI(4),AX(4),BX(4),CX(4),
     7              CTXG(4),UG(4),STXG(4),AY(4),BY(4),CY(4),CPYG(4),
     8              SPYG(4),VG(4),PSIIP(4),PHICI(4),CAC(4),CBC(4),CGC(4),
     9              FCXU(4),FCYU(4),FCZU(4),FS(4),CAXW(4),CBXW(4),CGXW(4)
      COMMON /DIMV/AS(4),BS(4),CS(4),CAS(4),CBS(4),CGS(4),BETP(4),
     1              BETBR(4),FSXU(4),FSYU(4),FSZU(4),FRXU(4),FRYU(4),
     2              FRZU(4),FXU(4),FYU(4),FZU(4),SI(4),F1FI(2),F1RI(2),
     3              F2FI(2),F2RI(2),CAH(4),CBH(4),CGH(4)
      DIMENSION XP(4),YP(4),ZP(4),PHII(4),PSII(4)
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      EQUIVALENCE (XP(1),X1P),(YP(1),Y1P),(ZP(1),Z1P),(PHII(1),PHI1),   MTRX0500
     1            (PSII(1),PSI1)                                        MTRX0510
      COMMON /COMP/SUMM,THETN,PHIN,PSIN,PI,RAD,GAM1,GAM2,GAM3,GAM4,GAM5,MTRX0520
     1            GAM6,GAM7,GAM8,GAM9,THETT,PHIT,PSIT,ZRO,TRO2,         MTRX0530
     2             TFO2,TIZ,RHO2,RHOMUR,AMUF,BMUR,ZPR,TM4,RHMR2,AO2APB, MTRX0540
     3             BO2APB,RFTF,TSO2,RRTS,BROMUR,XMUFO2,AXMFO2,XMTFO4,   MTRX0550
     4             XIZR,RTR,RHMR2I,XIXP,XIZP,XIXZP,XIYZP,D1PD2,D1MD2,   MTRX0560
     5             ZRD3,ZRD3R,ZFD3R,ZFD12,TIZ2,TG61,DD1P2,DD1M2,RPR,PHRPMTRX0570
     6            ,TANTP,SPHTP,CPHTP,SECTP,SFXS,SFYS,SFZS,SNPS,SNTS,    MTRX0580
     7             SNPSS,TPR,CAY,CBY,CGY,CAX,CBX,CGX,SFYU,SFXU,SFYUF,   MTRX0590
     8             SFYUR,SFZU,COSTH,SINTH,COSPS,SINPS,COSPH,SINPH,ANG1, MTRX0600
     9             ANG2,CPHI,SPHI,CPSI,SPSI,P1,P7,P3,P4,P5,P6,TX,TY,TZ  MTRX0610
      COMMON /COMP/TRH,DISTX,DISTY,DISTD,DISTS,D21,ZETA4,ZETA4D,ZETA3,  MTRX0620
     1             ZETA3D,SFZ1,SNPU,SNTU,HCGH1,HCGH2,HCGH3,HCGH4,TERM1, MTRX0630
     2             TERM2,SNPSU,SNPR,HCBH1,HCBH2,HCBH3,HCBH4,HCAH1,HCAH2,MTRX0640
     3             HCAH3,HCAH4,UQ,WP,UR,QR,VP,PR,P2,Q2,R2,VR,WQ,PQ,PHIR2MTRX0650
     4            ,PHIRD2,RPHRD,GCTH,GSTH,GCTSP,GCTCP,XXX,YYY,IX,IY,XX1,MTRX0660
     5             XX2,YY1,YY2,THG1,THG2,PHG1,PHG2,ZZ1,ZZ2,LLL          MTRX0670
      DIMENSION HCAH(4),HCBH(4),HCGH(4)                                 MTRX0680
      EQUIVALENCE (HCAH(1),HCAH1),(HCBH(1),HCBH1),(HCGH(1),HCGH1)       MTRX0690
      COMMON/ADTNL/ U1,U2,U3,U4,V1,V2,V3,V4,W1,W2,W3,W4,                MTRX0700
     1               XIYP,SPHIC,CPHIC,APTCH1,APTCH2,APTCH3,APTCH4,      MTRX0710
     2               SLOPE1,SLOPE2,XTRA(300)                            MTRX0720
      DIMENSION UI(4),VI(4),WI(4)                                       MTRX0730
      EQUIVALENCE (UI(1),U1),(VI(1),V1),(WI(1),W1)                      MTRX0740
      DIMENSION APITCH(4)                                               MTRX0750
      EQUIVALENCE (APITCH(1),APTCH1)                                    MTRX0760
    1 CALL CLEAR (DMATX,DMATX(10,11))                                   MTRX0770
      DMATX(1,1) = SUMM                                                 MTRX0780
      DMATX(1,5) = GAM2                                                 MTRX0790
      DMATX(1,6) = RHOMUR*PHIR                                          MTRX0800
    2 DMATX(2,2) = SUMM                                                 MTRX0810
       DMATX(2,4) = -GAM2                                               MTRX0820
      DMATX(2,6) = GAM1                                                 MTRX0830
      DMATX(2,10) = -RHOMUR                                             MTRX0840
    3 DMATX(3,3) = XMS                                                  MTRX0850
    4 DMATX(4,2) = -GAM3                                                MTRX0860
      DMATX(4,4) = XIX+XIXP                                             MTRX0870
      DMATX(4,6) = -XIXZ-XIXZP                                          MTRX0880
      DMATX(4,10) = RHOMUR*ZRD3                                         MTRX0890
    5 DMATX(5,1) = GAM2                                                 MTRX0900
      DMATX(5,5) = XIY+XIYP                                             MTRX0910
      DMATX(5,6) = -XIYZP                                               MTRX0920
    6 DMATX(6,1) = DMATX(1,6)                                           MTRX0930
      DMATX(6,2) = GAM1                                                 MTRX0940
      DMATX(6,4) = DMATX(4,6)+BROMUR                                    MTRX0950
      DMATX(6,5) = -XIYZP                                               MTRX0960
      DMATX(6,6) = XIZR+XIZP                                            MTRX0970
      DMATX(6,10) = BROMUR                                              MTRX0980
    7 DMATX(7,3) = XMUFO2                                               MTRX0990
      DMATX(7,4) = XMTFO4                                               MTRX1000
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      DMATX(7,5) = -AXMFO2                                              MTRX1010
      DMATX(7,7) = XMUFO2                                               MTRX1020
    8 DMATX(8,3) = XMUFO2                                               MTRX1030
      DMATX(8,4) = -XMTFO4                                              MTRX1040
      DMATX(8,5) = -AXMFO2                                              MTRX1050
      DMATX(8,8) = XMUFO2                                               MTRX1060
    9 DMATX(9,3) = XMUR                                                 MTRX1070
      DMATX(9,4) = -DMATX(1,6)                                          MTRX1080
      DMATX(9,5) = BMUR                                                 MTRX1090
      DMATX(9,9) = XMUR                                                 MTRX1100
      DMATX(9,10) = DMATX(9,4)                                          MTRX1110
   10 DMATX(10,2) = -RHOMUR                                             MTRX1120
      DMATX(10,3) = DMATX(9,4)                                          MTRX1130
      DMATX(10,4) = XIR+ZRD3R*RHOMUR                                    MTRX1140
      DMATX(10,5) = -BROMUR*PHIR                                        MTRX1150
      DMATX(10,6) = BROMUR                                              MTRX1160
      DMATX(10,9) = DMATX(9,4)                                          MTRX1170
      DMATX(10,10) = RHMR2I                                             MTRX1180
   11 GCTSP = G*AMTX(3,2)                                               MTRX1190
      GCTCP = G*AMTX(3,3)                                               MTRX1200
   12 DMATX(1,11) = SUMM*(VR-WQ-GSTH)-GAM2*PR+RHOMUR*PHIR*PQ+GAM1*(Q2+   MTRX1210
     1              R2)-GAM6*Q-2.0*RHOMUR*RPHRD+SFXS+SFXU               MTRX1220
      DMATX(2,11) = SUMM*(WP-UR+GCTSP)+GAM6*P-GAM1*PQ-GAM2*QR-RHOMUR*   MTRX1230
     1              PHIR*(P2+R2+PHIRD2)+SFYS+SFYU                       MTRX1240
      DMATX(3,11) = XMS*(UQ-VP+GCTCP)-SFZ1+SFZS                         MTRX1250
      DMATX(4,11) = GAM3*(UR-WP-GCTSP)+(XIXZ+XIXZP)*PQ-GAM7*P+(XIY-XIZ+ MTRX1260
     1              XIXP)*QR-GAM4*(P2+R2)+RHOMUR*PHIR*ZRD3*PHIRD2+SNPS+ MTRX1270
     2              SNPU                                                MTRX1280
      DMATX(5,11) = XIXZ*(R2-P2)+(XIZ-XIX-XIYP)*PR+GAM2*(VR-WQ-GSTH)-   MTRX1290
     1              (GAM7+2.*RHO*TG61)*Q+(XIXZP-BROMUR)*(Q2+R2)-        MTRX1300
     2              XIYZP*PQ-2.0*XMUR*ZRD3R*RHO*RPHRD+SNTS+SNTU         MTRX1310
   13 DMATX(6,11) = (XIX-XIY-GAM5)*PQ-(XIXZ+XIXZP-BROMUR)*QR+GAM8*Q+    MTRX1320
     1              XIYZP*PR+GAM9*P+RHOMUR*PHIR*(VR-WQ-2.0*RHO*RPHRD-B* MTRX1330
     2              (Q2-P2-PHIRD2)-GSTH)+GAM1*(WP-UR+GCTSP)+SNPSS+SNPSU MTRX1340
      DMATX(7,11) = XMUFO2*(UQ-VP-A*PR-TFO2*QR+(ZF+DEL1)*(P2+Q2)+GCTCP)+MTRX1350
     1              FZU(1)+SI(1)                                        MTRX1360
      DMATX(8,11) = XMUFO2*(UQ-VP-A*PR+TFO2*QR+(ZF+DEL2)*(P2+Q2)+GCTCP)+MTRX1370
     1              FZU(2)+SI(2)                                        MTRX1380
      DMATX(9,11) = XMUR*(UQ-VP+RHO*PHIRD2+2.0*P*RHO*PHIRD+B*PR+RHO*PHIRMTRX1390
     1              *QR+ZRD3R*(P2+Q2)+GCTCP)+FZU(3)+FZU(4)+SI(3)+SI(4)  MTRX1400
   14 DMATX(10,11) = RHOMUR*(UR-WP-2.0*P*(DEL3D-RHO*PHIR*PHIRD)-B*PQ+   MTRX1410
     1               RHO*PHIR*(P2+R2)+ZRD3R*QR-GCTH*SIN(PHIT+PHIR))+    MTRX1420
     2          PHIR*RHOMUR*(VP-UQ-2.0*P*RHO*PHIRD-B*PR-RHO*PHIR*QR-    MTRX1430
     3               ZRD3R*(P2+Q2))-XIR*PHIR*(R2-Q2)-XIR*QR+            MTRX1440
     4               SNPR                                               MTRX1450
      RETURN                                                            MTRX1460
      END                                                               MTRX1470
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      SUBROUTINE MTRXIR                                                 MTXI0010
C              HVOSM-VD2 VERSION                                        MTXI0020
C              REVISED OCTOBER 1975   CALSPAN CORPORATION               MTXI0030
      COMMON/INPT/PHIO,THETAO,PSIO,PO,QO,RO,XCOP,YCOP,ZCOP,UO,VO,WO,    MTXI0040
     1           A,B,DEL10,DEL20,DEL30,PHIRO,DEL10D,DEL20D,DEL30D,      MTXI0050
     2           PHIROD,TF,TR,ZF,ZR,RHO,AKRS,XMUR,                      MTXI0060
     3           XMS,XMUF,XIX,XIY,XIZ,XIXZ,CF,AKF,XLAMF,OMEGF,CFP,EPSF,MTXI0070
     4           RF,CR,AKR,XLAMR,OMEGR,CRP,EPSR,RR,TS,THMAX,DTCOMP,TO,  MTXI0080
     5           T1,DTCMP1,DTPRNT,MODE,EBAR,EM,AAA,HMAX,HMIN,BET,G,     MTXI0090
     6           HED(36),DADE(3),XIR,X1,Y1,Z1,X2,Y2,Z2,PHIC(50),DELB,   MTXI0100
     7           DELE,DDEL,NDEL,PSIF(50),TQF(50),TQR(50),TB,TE,TINCR,   MTXI0110
     8           NZTAB,NZ5,XBDRY(4,5),PSBDRY(4,5),YBDRY(2,5),NBX(5),    MTXI0120
     9           NBY(5),NTBL1,NTBL2,NTBL3,ZGP(21,21,5)                  MTXI0130
      COMMON/INPT/XB(5),XE(5),XINCR(5),NX(5),YB(5),YE(5),YINCR(5),NY(5),MTXI0140
     1          XXZGP5(21),YYZGP5(21),AMUG(5),PSBDRO(4,5),UVWMIN,PQRMIN MTXI0150
      COMMON /INTG/NEQ,T,DT,VAR(50),DER(50)                             MTXI0160
      EQUIVALENCE (U,VAR(1)),(V,VAR(2)),(W,VAR(3)),(P,VAR(4)),(Q,VAR(5))MTXI0170
     1          ,(R,VAR(6)),(DEL1,VAR(7)),(DEL1D,VAR(8)),(DEL2,VAR(9)),MTXI0180
     2           (DEL2D,VAR(10)),(DEL3,VAR(11)),(DEL3D,VAR(12)),        MTXI0190
     3           (PHIR,VAR(13)),(PHIRD,VAR(14)),(THETTP,VAR(15)),       MTXI0200
     4           (PHITP,VAR(16)),(PSITP,VAR(17)),(XCP,VAR(18)),         MTXI0210
     5           (YCP,VAR(19)),(ZCP,VAR(20)),(PSIFI,VAR(21)),           MTXI0220
     6           (PSIFID,VAR(22))                                       MTXI0230
      EQUIVALENCE (DU,DER(1)),(DV,DER(2)),(DW,DER(3)),(DP,DER(4)),      MTXI0240
     1           (DQ,DER(5)),(DR,DER(6)),(DDEL1,DER(7)),(DDEL1D,DER(8))MTXI0250
     2          ,(DDEL2,DER(9)),(DDEL2D,DER(10)),(DDEL3,DER(11)),       MTXI0260
     3           (DDEL3D,DER(12)),(DPHIR,DER(13)),(DPHIRD,DER(14)),     MTXI0270
     4           (DTHTTP,DER(15)),(DPHITP,DER(16)),(DPSITP,DER(17)),    MTXI0280
     5           (DXCP,DER(18)),(DYCP,DER(19)),(DZCP,DER(20)),          MTXI0290
     6           (DPSIFI,DER(21)),(DDPSFI,DER(22))                      MTXI0300
      EQUIVALENCE (VAR(9),PHIF),(VAR(10),PHIFD),(DER(9),DPHIF),         MTXI0310
     1           (DER(10),DPHIFD)                                       MTXI0320
      EQUIVALENCE (VAR(13),DEL4),(VAR(14),DEL4D),(DER(13),DDEL4),       MTXI0330
     1           (DER(14),DDEL4D)                                       MTXI0340
      COMMON /DIMV/X1P,X2P,X3P,X4P,Y1P,Y2P,Y3P,Y4P,Z1P,Z2P,Z3P,Z4P,PHI1,MTXI0350
     1            PHI2,PHI3,PHI4,PSI1,PSI2,PSI3,PSI4,CAYW(4),CBYW(4),   MTXI0360
     2            CGYW(4),ZPGI(4),THGI(4),PHGI(4),CPG(4),SPG(4),CTG(4),MTXI0370
     3            STG(4),CAGZ(4),CBGZ(4),CGGZ(4),D1(4),D2(4),D3(4),     MTXI0380
     4            XLM1(4),XLM2(4),XLM3(4),AMTX(3,3),CMTX(3,4),XGPP(4),  MTXI0390
     5            YGPP(4),ZGPP(4),DMATX(10,11),DELTA(4),CAR(4),CBR(4),  MTXI0400
     6            CGR(4),FR(4),HI(4),FC(4),TI(4),AX(4),BX(4),CX(4),     MTXI0410
     7            CTXG(4),UG(4),STXG(4),AY(4),BY(4),CY(4),CPYG(4),      MTXI0420
     8            SPYG(4),VG(4),PSIIP(4),PHICI(4),CAC(4),CBC(4),CGC(4),MTXI0430
     9            FCXU(4),FCYU(4),FCZU(4),FS(4),CAXW(4),CBXW(4),CGXW(4)MTXI0440
      COMMON /DIMV/AS(4),BS(4),CS(4),CAS(4),CBS(4),CGS(4),BETP(4),      MTXI0450
     1            BETBR(4),FSXU(4),FSYU(4),FSZU(4),FRXU(4),FRYU(4),     MTXI0460
     2            FRZU(4),FXU(4),FYU(4),FZU(4),SI(4),F1F1(2),F1RI(2),   MTXI0470
     3            F2FI(2),F2RI(2),CAH(4),CBH(4),CGH(4)                  MTXI0480
      DIMENSION XP(4),YP(4),ZP(4),PHII(4),PSII(4)                       MTXI0490
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      EQUIVALENCE (XP(1),X1P),(YP(1),Y1P),(ZP(1),Z1P),(PHII(1),PHI1),   MTXI0500
     1            (PSII(1),PSI1)                                        MTXI0510
      COMMON /COMP/SUMM,THETN,PHIN,PSIN,PI,RAD,GAM1,GAM2,GAM3,GAM4,GAM5,MTXI0520
     1            GAM6,GAM7,GAM8,GAM9,THETT,PHIT,PSIT,ZRO,TRO2,         MTXI0530
     2             TFO2,TIZ,RHO2,RHOMUR,AMUF,BMUR,ZPR,TM4,RHMR2,AO2APB, MTXI0540
     3             BO2APB,RFTF,TSO2,RRTS,BROMUR,XMUFO2,AXMFO2,XMTFO4,   MTXI0550
     4             XIZR,RTR,RHMR2I,XIXP,XIZP,XIXZP,XIYZP,D1PD2,D1MD2,   MTXI0560
     5             ZRD3,ZRD3R,ZFD3R,ZFD12,TIZ2,TG61,DD1P2,DD1M2,RPR,PHRPMTXI0570
     6            ,TANTP,SPHTP,CPHTP,SECTP,SFXS,SFYS,SFZS,SNPS,SNTS,    MTXI0580
     7             SNPSS,TPR,CAY,CBY,CGY,CAX,CBX,CGX,SFYU,SFXU,SFYUF,   MTXI0590
     8             SFYUR,SFZU,COSTH,SINTH,COSPS,SINPS,COSPH,SINPH,ANG1, MTXI0600
     9             ANG2,CPHI,SPHI,CPSI,SPSI,P1,P7,P3,P4,P5,P6,TX,TY,TZ  MTXI0610
      COMMON /COMP/TRH,DISTX,DISTY,DISTD,DISTS,D21,ZETA4,ZETA4D,ZETA3,  MTXI0620
     1             ZETA3D,SFZ1,SNPU,SNTU,HCGH1,HCGH2,HCGH3,HCGH4,TERM1, MTXI0630
     2             TERM2,SNPSU,SNPR,HCBH1,HCBH2,HCBH3,HCBH4,HCAH1,HCAH2,MTXI0640
     3             HCAH3,HCAH4,UQ,WP,UR,QR,VP,PR,P2,Q2,R2,VR,WQ,PQ,PHIR2MTXI0650
     4            ,PHIRD2,RPHRD,GCTH,GSTH,GCTSP,GCTCP,XXX,YYY,IX,IY,XX1,MTXI0660
     5             XX2,YY1,YY2,THG1,THG2,PHG1,PHG2,ZZ1,ZZ2,LLL          MTXI0670
      DIMENSION HCAH(4),HCBH(4),HCGH(4)                                 MTXI0680
      EQUIVALENCE (HCAH(1),HCAH1),(HCBH(1),HCBH1),(HCGH(1),HCGH1)       MTXI0690
      COMMON/ADTNL/ U1,U2,U3,U4,V1,V2,V3,V4,W1,W2,W3,W4,                MTXI0700
     1              XIYP,SPHIC,CPHIC,APTCH1,APTCH2,APTCH3,APTCH4,       MTXI0710
     2              SLOPE1,SLOPE2,XTRA(300)                             MTXI0720
      DIMENSION UI(4),VI(4),WI(4)                                       MTXI0730
      EQUIVALENCE (UI(1),U1),(VI(1),V1),(WI(1),W1)                      MTXI0740
      DIMENSION APITCH(4)                                               MTXI0750
      EQUIVALENCE (APITCH(1),APTCH1)                                    MTXI0760
      COMMON /SUSCMP/ XMURO2,BXMRO2,XMTRO4,ZFO,TSFO2,RHOF2,RHFMUF,      MTXI0770
     1                RHF2MF,RF2MFI,RTF,RRTR,D3PD4,D3MD4,D43,DD3P4,     MTXI0780
     2                DD3M4,ZFD1RF,ZRD34,RFPF,RPF2M,WFMF,PHFP,PHIF2,    MTXI0790
     3                PHIFD2,RPHFD,ZFD1,ZFD2,ZRD4,TPF,SLOPE3,SLOPE4,    MTXI0800
     4                PHI3D,PHI4D,DTHF1,DTHF2,DTHR3,DTHR4,DTDD1,        MTXI0810
     5                DTDD2,DTDD3,DTDD4,FJF(4),SNPF                     MTXI0820
C                                                                       MTXI0830
      CALL CLEAR(DMATX(1,1),DMATX(10,11))                               MTXI0840
      DMATX(1,1) = SUMM                                                 MTXI0850
      DMATX(1,5) = GAM2                                                 MTXI0860
      DMATX(2,2) = SUMM                                                 MTXI0870
      DMATX(2,4) = -GAM2                                                MTXI0880
      DMATX(2,6) = GAM1                                                 MTXI0890
      DMATX(3,3) = XMS                                                  MTXI0900
      DMATX(4,2) = -GAM2                                                MTXI0910
      DMATX(4,4) = XIX+XIXP                                             MTXI0920
      DMATX(4,6) = -XIXZ-XIXZP                                          MTXI0930
      DMATX(5,1) = GAM2                                                 MTXI0940
      DMATX(5,5) = XIY+XIYP                                             MTXI0950
      DMATX(5,6) = -XIYZP                                               MTXI0960
      DMATX(6,2) = GAM1                                                 MTXI0970
      DMATX(6,4) = -XIXZ-XIXZP                                          MTXI0980
      DMATX(6,5) = -XIYZP                                               MTXI0990
      DMATX(6,6) = XIZ+XIZP                                             MTXI1000
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      DMATX(7,3) = XMUFO2
      DMATX(7,4) = XMTFO4
      DMATX(7,5) = -AXMFO2
      DMATX(7,7) = XMUFO2
      DMATX(8,3) = XMUFO2
      DMATX(8,4) = -XMTFO4
      DMATX(8,5) = -AXMFO2
      DMATX(8,8) = XMUFO2
      DMATX(9,3) = XMURO2
      DMATX(9,4) = XMTRO4
      DMATX(9,5) = BXMRO2
      DMATX(9,9) = XMURO2
      DMATX(10,3) = XMURO2
      DMATX(10,4) = -XMTRO4
      DMATX(10,5) = BXMRO2
      DMATX(10,10) = XMURO2
      GCTSP = G*AMTX(3,2)
      GCTCP = G*AMTX(3,3)
      DMATX(1,11) = SUMM*(VR-WQ-GSTH)+GAM1*(Q2+R2)-GAM2*PR-GAM6*Q
     1             +SFXU+SFXS
      DMATX(2,11) = SUMM*(WP-UR+GCTSP)-GAM1*PQ-GAM2*QR+GAM6*P
     1             +SFYU+SFYS
      DMATX(3,11) = XMS*(UQ-VP+GCTCP)-SFZ1+SFZS
      DMATX(4,11) = -GAM2*(WP-UR+GCTSP)+(XIXZ+XIXZP)*PQ-XIYZP*(P2+R2)
     1             +(XIY-XIZ+XIXP)*QR-GAM7*P+SNPU+SNPS
      DMATX(5,11) = GAM2*(VR-WQ-GSTH)-(XIX-XIZ+XIYP)*PR-GAM7*Q
     1             +XIXZP*(Q2+R2)-XIYZP*PQ+XIXZ*(R2-P2)+SNTU+SNTS
      DMATX(6,11) = GAM1*(WP-UR+GCTSP)+(XIX-XIY-GAM5)*PQ-(XIXZ+XIXZP)
     1             *QR+GAM8*Q+XIYZP*PR+GAM9*P+SNPSU+SNPSS
      DMATX(7,11) = XMUFO2*(UQ-VP+GCTCP-A*PR+ZFD1*(P2+R2)
     1             -TFO2*QR)+FZU(1)+SI(1)
      DMATX(8,11) = XMUFO2*(UQ-VP+GCTCP-A*PR+ZFD2*(P2+R2)
     1             +TFO2*QR)+FZU(2)+SI(2)
      DMATX(9,11) = XMURO2*(UQ-VP+GCTCP+B*PR+ZRD3*(P2+R2)
     1             -TRO2*QR)+FZU(3)+SI(3)
      DMATX(10,11) = XMURO2*(UQ-VP+GCTCP+B*PR+ZRD4*(P2+R2)
     1             +TRO2*QR)+FZU(4)+SI(4)
      RETURN
      END
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      SUBROUTINE MTRXSF
C          HVOSM-VD2 VERSION
C          REVISED OCTOBER 1975   CALSPAN CORPORATION
      COMMON/INPT/PHIO,THETAO,PSIO,PO,QO,RO,XCOP,YCOP,ZCOP,UO,VO,WO,
     1          A,B,DEL10,DEL20,DEL30,PHIRO,DEL10D,DEL20D,DEL30D,
     2          PHIROD,TF,TR,ZF,ZR,RHO,AKRS,XMUR,
     3          XMS,XMUF,XIX,XIY,XIZ,XIXZ,CF,AKF,XLAMF,OMEGF,CFP,EPSF,
     4          RF,CR,AKR,XLAMR,OMEGR,CRP,EPSR,RR,TS,THMAX,DTCOMP,TO,
     5          T1,DTCMP1,DTPRNT,MODE,EBAR,EM,AAA,HMAX,HMIN,BET,G,
     6          HED(36),DADE(3),X1R,X1,Y1,Z1,X2,Y2,Z2,PHIC(50),DELB,
     7          DELE,DDEL,NDEL,PSIF(50),TQF(50),TQR(50),TB,TE,TINCR,
     8          NZTAB,NZ5,XBDRY(4,5),PSBDRY(4,5),YBDRY(2,5),NBX(5),
     9          NBY(5),NTBL1,NTBL2,NTBL3,ZGP(21,21,5)
      COMMON/INPT/XB(5),XE(5),XINCR(5),NX(5),YB(5),YE(5),YINCR(5),NY(5),
     1        XXZGP5(21),YYZGP5(21),AMUG(5),PSBDRO(4,5),UVWMIN,PQRMIN
      COMMON /INTG/NEQ,T,DT,VAR(50),DER(50)
      EQUIVALENCE (U,VAR(1)),(V,VAR(2)),(W,VAR(3)),(P,VAR(4)),(Q,VAR(5))
     1        ,(R,VAR(6)),(DEL1,VAR(7)),(DEL1D,VAR(8)),(DEL2,VAR(9)),
     2          (DEL2D,VAR(10)),(DEL3,VAR(11)),(DEL3D,VAR(12)),
     3          (PHIR,VAR(13)),(PHIRD,VAR(14)),(THETTP,VAR(15)),
     4          (PHITP,VAR(16)),(PSITP,VAR(17)),(XCP,VAR(18)),
     5          (YCP,VAR(19)),(ZCP,VAR(20)),(PSIFI,VAR(21)),
     6          (PSIFID,VAR(22))
      EQUIVALENCE (DU,DER(1)),(DV,DER(2)),(DW,DER(3)),(DP,DER(4)),
     1          (DQ,DER(5)),(DR,DER(6)),(DDEL1,DER(7)),(DDEL1D,DER(8))
     2        ,(DDEL2,DER(9)),(DDEL2D,DER(10)),(DDEL3,DER(11)),
     3          (DDEL3D,DER(12)),(DPHIR,DER(13)),(DPHIRD,DER(14)),
     4          (DTHTTP,DER(15)),(DPHITP,DER(16)),(DPSITP,DER(17)),
     5          (DXCP,DER(18)),(DYCP,DER(19)),(DZCP,DER(20)),
     6          (DPSIFI,DER(21)),(DDPSFI,DER(22))
      EQUIVALENCE (VAR(9),PHIF),(VAR(10),PHIFD),(DER(9),DPHIF),
     1          (DER(10),DPHIFD)
      EQUIVALENCE (VAR(13),DEL4),(VAR(14),DEL4D),(DER(13),DDEL4),
     1          (DER(14),DDEL4D)
      COMMON /DIMV/X1P,X2P,X3P,X4P,Y1P,Y2P,Y3P,Y4P,Z1P,Z2P,Z3P,Z4P,PHI1,
     1           PHI2,PHI3,PHI4,PSI1,PSI2,PSI3,PSI4,CAYW(4),CBYW(4),
     2           CGYW(4),ZPGI(4),THGI(4),PHGI(4),CPG(4),SPG(4),CTG(4),
     3           STG(4),CAGZ(4),CBGZ(4),CGGZ(4),D1(4),D2(4),D3(4),
     4           XLM1(4),XLM2(4),XLM3(4),AMTX(3,3),CMTX(3,4),XGPP(4),
     5           YGPP(4),ZGPP(4),DMATX(10,11),DELTA(4),CAR(4),CBR(4),
     6           CGR(4),FR(4),HI(4),FC(4),TI(4),AX(4),BX(4),CX(4),
     7           CTXG(4),UG(4),STXG(4),AY(4),BY(4),CY(4),CPYG(4),
     8           SPYG(4),VG(4),PSIIP(4),PHICI(4),CAC(4),CBC(4),CGC(4),
     9           FCXU(4),FCYU(4),FCZU(4),FS(4),CAXW(4),CBXW(4),CGXW(4)
      COMMON /DIMV/AS(4),BS(4),CS(4),CAS(4),CBS(4),CGS(4),BETP(4),
     1           BETBR(4),FSXU(4),FSYU(4),FSZU(4),FRXU(4),FRYU(4),
     2           FRZU(4),FXU(4),FYU(4),FZU(4),SI(4),F1FI(2),F1RI(2),
     3           F2FI(2),F2RI(2),CAH(4),CBH(4),CGH(4)
      DIMENSION XP(4),YP(4),ZP(4),PHII(4),PSII(4)
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      EQUIVALENCE (XP(1),X1P),(YP(1),Y1P),(ZP(1),Z1P),(PHII(1),PHI1),   MTXS0500
     1            (PSII(1),PSI1)                                        MTXS0510
      COMMON /COMP/SUMM,THETN,PHIN,PSIN,PI,RAD,GAM1,GAM2,GAM3,GAM4,GAM5,MTXS0520
     1            GAM6,GAM7,GAM8,GAM9,THETT,PHIT,PSIT,ZRO,TRO2,         MTXS0530
     2             TFO2,TIZ,RHO2,RHOMUR,AMUF,BMUR,ZPR,TM4,RHMR2,AO2APB, MTXS0540
     3             BO2APB,RFTF,TSO2,RRTS,BROMUR,XMUFO2,AXMFO2,XMTFO4,   MTXS0550
     4             XIZR,RTR,RHMR2I,XIXP,XIZP,XIXZP,XIYZP,D1PD2,D1MD2,   MTXS0560
     5             ZRD3,ZRD3R,ZFD3R,ZFD12,TIZ2,TG61,DD1P2,DD1M2,RPR,PHRPMTXS0570
     6            ,TANTP,SPHTP,CPHTP,SECTP,SFXS,SFYS,SFZS,SNPS,SNTS,    MTXS0580
     7             SNPSS,TPR,CAY,CBY,CGY,CAX,CBX,CGX,SFYU,SFXU,SFYUF,   MTXS0590
     8             SFYUR,SFZU,COSTH,SINTH,COSPS,SINPS,COSPH,SINPH,ANG1, MTXS0600
     9             ANG2,CPHI,SPHI,CPSI,SPSI,P1,P7,P3,P4,P5,P6,TX,TY,TZ  MTXS0610
      COMMON /COMP/TRH,DISTX,DISTY,DISTD,DISTS,D21,ZETA4,ZETA4D,ZETA3,  MTXS0620
     1             ZETA3D,SFZ1,SNPU,SNTU,HCGH1,HCGH2,HCGH3,HCGH4,TERM1, MTXS0630
     2             TERM2,SNPSU,SNPR,HCBH1,HCBH2,HCBH3,HCBH4,HCAH1,HCAH2,MTXS0640
     3             HCAH3,HCAH4,UQ,WP,UR,QR,VP,PR,P2,Q2,R2,VR,WQ,PQ,PHIR2MTXS0650
     4            ,PHIRD2,RPHRD,GCTH,GSTH,GCTSP,GCTCP,XXX,YYY,IX,IY,XX1,MTXS0660
     5             XX2,YY1,YY2,THG1,THG2,PHG1,PHG2,ZZ1,ZZ2,LLL          MTXS0670
      DIMENSION HCAH(4),HCBH(4),HCGH(4)                                 MTXS0680
      EQUIVALENCE (HCAH(1),HCAH1),(HCBH(1),HCBH1),(HCGH(1),HCGH1)       MTXS0690
      COMMON/ADTNL/ U1,U2,U3,U4,V1,V2,V3,V4,W1,W2,W3,W4,                MTXS0700
     1              XIYP,SPHIC,CPHIC,APTCH1,APTCH2,APTCH3,APTCH4,       MTXS0710
     2              SLOPE1,SLOPE2,XTRA(300)                             MTXS0720
      DIMENSION UI(4),VI(4),WI(4)                                       MTXS0730
      EQUIVALENCE (UI(1),U1),(VI(1),V1),(WI(1),W1)                      MTXS0740
      DIMENSION APITCH(4)                                               MTXS0750
      EQUIVALENCE (APITCH(1),APTCH1)                                    MTXS0760
      COMMON /INSUS/ XIF,RHOF,TSF,PHIFO,PHIFOD,DEL40,DEL40D,ISUS,       MTXS0770
     1               AKDS,AKDS1,AKDS2,AKDS3,PHIRC(50),DTHF(50),DTHR(50),MTXS0780
     2               NCAMF,NCAMR,NDTHF,NDTHR                            MTXS0790
      COMMON /SUSCMP/ XMURO2,BXMRO2,XMTRO4,ZFO,TSFO2,RHOF2,RHFMUF,      MTXS0800
     1                RHF2MF,RF2MFI,RTF,RRTR,D3PD4,D3MD4,D43,DD3P4,     MTXS0810
     2                DD3M4,ZFD1RF,ZRD34,RFPF,RPF2M,WFMF,PHFP,PHIF2,    MTXS0820
     3                PHIFD2,RPHFD,ZFD1,ZFD2,ZRD4,TPF,SLOPE3,SLOPE4,    MTXS0830
     4                PHI3D,PHI4D,DTHF1,DTHF2,DTHR3,DTHR4,DTDD1,        MTXS0840
     5                DTDD2,DTDD3,DTDD4,FJF(4),SNPF                     MTXS0850
C                                                                       MTXS0860
      CALL CLEAR(DMATX(1,1),DMATX(10,11))                               MTXS0870
      DMATX(1,1) = SUMM                                                 MTXS0880
      DMATX(1,5) = GAM2                                                 MTXS0890
      DMATX(1,6) = RHOMUR*PHIR+RHFMUF*PHIF                              MTXS0900
      DMATX(2,2) = SUMM                                                 MTXS0910
      DMATX(2,4) = -GAM2                                                MTXS0920
      DMATX(2,6) = GAM1                                                 MTXS0930
      DMATX(2,8) = -RHFMUF                                              MTXS0940
      DMATX(2,10)= -RHOMUR                                              MTXS0950
      DMATX(3,3) = XMS                                                  MTXS0960
      DMATX(4,2) = -GAM3                                                MTXS0970
      DMATX(4,4) = XIX+XIXP                                             MTXS0980
      DMATX(4,6) = -XIXZ-XIXZP                                          MTXS0990
      DMATX(4,8) = RHFMUF*ZFD1                                          MTXS1000
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      DMATX(4,10)= RHOMUR*ZRD3                                          MTXS1010
      DMATX(5,1) = GAM2                                                 MTXS1020
      DMATX(5,5) = XIY+XIYP                                             MTXS1030
      DMATX(5,6) = -XIYZP                                               MTXS1040
      DMATX(6,1) = RHFMUF*PHIF+RHOMUR*PHIR                              MTXS1050
      DMATX(6,2) = GAM1                                                 MTXS1060
      DMATX(6,4) = -XIXZ-XIXZP-RHFMUF*A+RHOMUR*B                        MTXS1070
      DMATX(6,5) = -XIYZP                                               MTXS1080
      DMATX(6,6) = XIZ+XIZP+XIR+XIF                                     MTXS1090
      DMATX(6,8) = -RHFMUF*A                                            MTXS1100
      DMATX(6,10)= BROMUR                                               MTXS1110
      DMATX(7,3) = XMUF                                                 MTXS1120
      DMATX(7,4) = -RHFMUF*PHIF                                         MTXS1130
      DMATX(7,5) = -AMUF                                                MTXS1140
      DMATX(7,7) = XMUF                                                 MTXS1150
      DMATX(7,8) = -RHFMUF*PHIF                                         MTXS1160
      DMATX(8,2) = -RHFMUF                                              MTXS1170
      DMATX(8,3) = -RHFMUF*PHIF                                         MTXS1180
      DMATX(8,4) = XIF+RHFMUF*ZFD1RF                                    MTXS1190
      DMATX(8,5) = AMUF*RFPF                                            MTXS1200
      DMATX(8,6) = -RHFMUF*A                                            MTXS1210
      DMATX(8,7) = -RHFMUF*PHIF                                         MTXS1220
      DMATX(8,8) = RF2MFI                                               MTXS1230
      DMATX(9,3) = XMUR                                                 MTXS1240
      DMATX(9,4) = -RHOMUR*PHIR                                         MTXS1250
      DMATX(9,5) = BMUR                                                 MTXS1260
      DMATX(9,9) = XMUR                                                 MTXS1270
      DMATX(9,10)= -RHOMUR*PHIR                                         MTXS1280
      DMATX(10,2) = -RHOMUR                                             MTXS1290
      DMATX(10,3) = -RHOMUR*PHIR                                        MTXS1300
      DMATX(10,4) = XIR+RHOMUR*ZRD3R                                    MTXS1310
      DMATX(10,5) = -BMUR*RPR                                           MTXS1320
      DMATX(10,6) = BROMUR                                              MTXS1330
      DMATX(10,9) = -RHOMUR*PHIR                                        MTXS1340
      DMATX(10,10)= RHMR2I                                              MTXS1350
      GCTSP = G*AMTX(3,2)                                               MTXS1360
      GCTCP = G*AMTX(3,3)                                               MTXS1370
      DMATX(1,11) = SUMM*(VR-WQ-GSTH)-GAM2*PR+(RHOMUR*PHIR+RHFMUF*PHIF) MTXS1380
     1             *PQ+GAM1*(Q2+R2)-GAM6*Q-2.0*(RHOMUR*RPHRD+RHFMUF*    MTXS1390
     2              RPHFD)+SFXU+SFXS                                    MTXS1400
      DMATX(2,11) = SUMM*(WP-UR+GCTSP)+GAM6*P-GAM1*PQ-GAM2*QR           MTXS1410
     1             -RHOMUR*PHIR*(P2+R2+PHIRD2)-RHFMUF*PHIF*(P2+R2+      MTXS1420
     2              PHIFD2)+SFYU+SFYS                                   MTXS1430
      DMATX(3,11) = XMS*(UQ-VP+GCTCP)-SFZ1+SFZS                         MTXS1440
      DMATX(4,11) = GAM3*(UR-WP-GCTSP)+(XIXZ+XIXZP)*PQ-GAM7*P           MTXS1450
     1             +(XIY-XIZ+XIXP)*QR-GAM4*(P2+R2)+RHOMUR*PHIR*ZRD3*    MTXS1460
     2              PHIRD2+RHFMUF*PHIF*ZFD1*PHIFD2+SNPS+SNPU            MTXS1470
      DMATX(5,11) = GAM2*(VR-WQ-GSTH)+XIXZ*(R2-P2)+(XIZ-XIX-XIYP)*PR    MTXS1480
     1             -GAM7*Q-2.0*Q*(RHOF*WFMF+RHO*TG61)+(XIXZP-BROMUR     MTXS1490
     2             +RHOF*AMUF)*(Q2+R2)-XIYZP*PQ-2.0*RHOMUR*ZRD3R*RPHRD  MTXS1500
     3             -2.0*RHFMUF*ZFD1RF*RPHFD+SNTU+SNTS                   MTXS1510
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      DMATX(6,11) = GAM1*(WP-UR+GCTSP)+(XIX-XIY-GAM5)*PQ
     1            -(XIXZ+XIXZP-BROMUR+AMUF*RHOF)*QR+GAM8*Q+XIYZP*PR
     2            +GAM9*P+XMUR*RPR*(VR-WQ-2.0*RHO*RPHRD-B*(Q2-P2
     3            -PHIRD2)-GSTH)+XMUF*RFPF*(VR-WQ-2.0*RHOF*RPHFD
     4            +A*(Q2-P2-PHIFD2)-GSTH)+SNPSS+SNPSU
      DMATX(7,11) = XMUF*(UQ-VP+RHOF*PHIFD2+2.0*P*RHOF*PHIFD-A*PR
     1            +RFPF*QR+ZFD1RF*(P2+Q2)+GCTCP)
     2            +FZU(1)+FZU(2)+SI(1)+SI(2)
      DMATX(8,11) = RHFMUF*(UR-WP-2.0*P*DEL1D+2.0*P*RFPF*PHIFD+A*PQ
     1            +RFPF*(P2+R2)+ZFD1RF*QR-GCTH*SIN(PHIT+PHIF))
     2            +RHFMUF*PHIF*(VP-UQ-2.0*P*RHOF*PHIFD+A*PR
     3            -ZFD1RF*(P2+Q2))-XIF*PHIF*(R2-Q2)-XIF*QR+SNPF
      DMATX(9,11) = XMUR*(UQ-VP+RHO*PHIRD2+2.0*P*RHO*PHIRD+B*PR
     1            +RPR*QR+ZRD3R*(P2+Q2)+GCTCP)
     2            +FZU(3)+FZU(4)+SI(3)+SI(4)
      DMATX(10,11)= RHOMUR*(UR-WP-2.0*P*DEL3D+2.0*P*RPR*PHIRD-B*PQ
     1            +RPR*(P2+R2)+ZRD3R*QR-GCTH*SIN(PHIT+PHIR))
     2            +RHOMUR*PHIR*(VP-UQ-2.0*P*RHO*PHIRD-B*PR
     3            -ZRD3R*(P2+Q2))-XIR*PHIR*(R2-Q2)-XIR*QR+SNPR
      RETURN
      END
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      SUBROUTINE OUTPUT(IND)                                            OUTP0010
C              HVOSM-VD2 VERSION                                        OUTP0020
C              REVISED OCTOBER 1975  CALSPAN CORPORATION                OUTP0030
      COMMON/HEAD/ VHED(20),CHED(20),GHED(20),SHED(20),THED(20),        OUTP0040
     1           NPAGE(20)                                              OUTP0050
      COMMON/INPT/PHIO,THETAO,PSIO,PO,QO,RO,XCOP,YCOP,ZCOP,UO,VO,WO,    OUTP0060
     1          A,B,DEL10,DEL20,DEL30,PHIRO,DEL10D,DEL20D,DEL30D,       OUTP0070
     2          PHIROD,TF,TR,ZF,ZR,RHO,AKRS,XMUR,                       OUTP0080
     3          XMS,XMUF,XIX,XIY,XIZ,XIXZ,CF,AKF,XLAMF,OMEGF,CFP,EPSF,OUTP0090
     4          RF,CR,AKR,XLAMR,OMEGR,CRP,EPSR,RR,TS,THMAX,DTCOMP,TO,   OUTP0100
     5          T1,DTCMP1,DTPRNT,MODE,EBAR,EM,AAA,HMAX,HMIN,BET,G,      OUTP0110
     6          HED(36),DADE(3),XIR,X1,Y1,Z1,X2,Y2,Z2,PHIC(50),DELB,    OUTP0120
     7          DELE,DDEL,NDEL,PSIF(50),TQF(50),TQR(50),TB,TE,TINCR,    OUTP0130
     8          NZTAB,NZ5,XBDRY(4,5),PSBDRY(4,5),YBDRY(2,5),NBX(5),     OUTP0140
     9          NBY(5),NTBL1,NTBL2,NTBL3,ZGP(21,21,5)                   OUTP0150
      COMMON/INPT/XB(5),XE(5),XINCR(5),NX(5),YB(5),YE(5),YINCR(5),NY(5),OUTP0160
     1        XXZGP5(21),YYZGP5(21),AMUG(5),PSBDRO(4,5),UVWMIN,PQRMIN OUTP0170
      COMMON /INTG/NEQ,T,DT,VAR(50),DER(50)                             OUTP0180
      EQUIVALENCE (U,VAR(1)),(V,VAR(2)),(W,VAR(3)),(P,VAR(4)),(Q,VAR(5))OUTP0190
     1       ,(R,VAR(6)),(DEL1,VAR(7)),(DEL1D,VAR(8)),(DEL2,VAR(9)),OUTP0200
     2          (DEL2D,VAR(10)),(DEL3,VAR(11)),(DEL3D,VAR(12)),         OUTP0210
     3          (PHIR,VAR(13)),(PHIRD,VAR(14)),(THETTP,VAR(15)),        OUTP0220
     4          (PHITP,VAR(16)),(PSITP,VAR(17)),(XCP,VAR(18)),          OUTP0230
     5          (YCP,VAR(19)),(ZCP,VAR(20)),(PSIFI,VAR(21)),            OUTP0240
     6          (PSIFID,VAR(22))                                        OUTP0250
      EQUIVALENCE (DU,DER(1)),(DV,DER(2)),(DW,DER(3)),(DP,DER(4)),      OUTP0260
     1          (DQ,DER(5)),(DR,DER(6)),(DDEL1,DER(7)),(DDEL1D,DER(8))OUTP0270
     2       ,(DDEL2,DER(9)),(DDEL2D,DER(10)),(DDEL3,DER(11)),          OUTP0280
     3          (DDEL3D,DER(12)),(DPHIR,DER(13)),(DPHIRD,DER(14)),      OUTP0290
     4          (DTHTTP,DER(15)),(DPHITP,DER(16)),(DPSITP,DER(17)),     OUTP0300
     5          (DXCP,DER(18)),(DYCP,DER(19)),(DZCP,DER(20)),           OUTP0310
     6          (DPSIFI,DER(21)),(DDPSFI,DER(22))                       OUTP0320
      EQUIVALENCE (VAR(9),PHIF),(VAR(10),PHIFD),(DER(9),DPHIF),         OUTP0330
     1          (DER(10),DPHIFD)                                        OUTP0340
      EQUIVALENCE (VAR(13),DEL4),(VAR(14),DEL4D),(DER(13),DDEL4),       OUTP0350
     1          (DER(14),DDEL4D)                                        OUTP0360
      COMMON /DIMV/X1P,X2P,X3P,X4P,Y1P,Y2P,Y3P,Y4P,Z1P,Z2P,Z3P,Z4P,PHI1,OUTP0370
     1           PHI2,PHI3,PHI4,PSI1,PSI2,PSI3,PSI4,CAYW(4),CBYW(4),    OUTP0380
     2           CGYW(4),ZPGI(4),THGI(4),PHGI(4),CPG(4),SPG(4),CTC(4),OUTP0390
     3           STG(4),CAGZ(4),CBGZ(4),CGGZ(4),D1(4),D2(4),D3(4),      OUTP0400
     4           XLM1(4),XLM2(4),XLM3(4),AMTX(3,3),CMTX(3,4),XGPP(4),   OUTP0410
     5           YGPP(4),ZGPP(4),DMATX(10,11),DELTA(4),CAR(4),CBR(4),   OUTP0420
     6           CGR(4),FR(4),HI(4),FC(4),TI(4),AX(4),BX(4),CX(4),      OUTP0430
     7           CTXG(4),UG(4),STXG(4),AY(4),BY(4),CY(4),CPYG(4),       OUTP0440
     8           SPYG(4),VG(4),PSIIP(4),PHICI(4),CAC(4),CBC(4),CGC(4),OUTP0450
     9           FCXU(4),FCYU(4),FCZU(4),FS(4),CAXW(4),CBXW(4),CGXW(4)OUTP0460
      COMMON /DIMV/AS(4),BS(4),CS(4),CAS(4),CBS(4),CGS(4),BETP(4),      OUTP0470
     1           BETBR(4),FSXU(4),FSYU(4),FSZU(4),FRXU(4),FRYU(4),      OUTP0480
     2           FRZU(4),FXU(4),FYU(4),FZU(4),SI(4),F1FI(2),F1RI(2),    OUTP0490
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3             F2FI(2),F2RI(2),CAH(4),CBH(4),CGH(4)                       OUTP0500
 DIMENSION XP(4),YP(4),ZP(4),PHII(4),PSII(4)                             OUTP0510
 EQUIVALENCE (XP(1),X1P),(YP(1),Y1P),(ZP(1),Z1P),(PHII(1),PHI1),         OUTP0520
1             (PSII(1),PSI1).                                            OUTP0530
 COMMON /COMP/SUMM,THETN,PHIN,PSIN,PI,RAD,GAM1,GAM2,GAM3,GAM4,GAM5,OUTP0540
1            GAM6,GAM7,GAM8,GAM9,THETT,PHIT,PSIT,ZRO,TRO2,               OUTP0550
2             TFO2,TIZ,RHO2,RHOMUR,AMUF,BMUR,ZPR,TM4,RHMR2,AO2APB,       OUTP0560
3             BO2APB,RFTF,TSO2,RRTS,BROMUR,XMUFO2,AXMFO2,XMTFO4,         OUTP0570
4             XIZR,RTR,RHMR2I,XIXP,XIZP,XIXZP,XIYZP,D1PD2,D1MD2,         OUTP0580
5             ZRD3,ZRD3R,ZFD3R,ZFD12,TIZ2,TG61,DD1P2,DD1M2,RPR,PHRPOUTP0590
6            ,TANTP,SPHTP,CPHTP,SECTP,SFXS,SFYS,SFZS,SNPS,SNTS,          OUTP0600
7             SNPSS,TPR,CAY,CBY,CGY,CAX,CBX,CGX,SFYU,SFXU,SFYUF,         OUTP0610
8             SFYUR,SFZU,COSTH,SINTH,COSPS,SINPS,COSPH,SINPH,ANG1,       OUTP0620
9             ANG2,CPHI,SPHI,CPSI,SPSI,P1,P7,P3,P4,P5,P6,TX,TY,TZ        OUTP0630
 COMMON /COMP/TRH,DISTX,DISTY,DISTD,DISTS,D21,ZETA4,ZETA4D,ZETA3,        OUTP0640
1             ZETA3D,SFZ1,SNPU,SNTU,HCGH1,HCGH2,HCGH3,HCGH4,TERM1,       OUTP0650
2             TERM2,SNPSU,SNPR,HCBH1,HCBH2,HCBH3,HCBH4,HCAH1,HCAH2,OUTP0660
3             HCAH3,HCAH4,UQ,WP,UR,QR,VP,PR,P2,Q2,R2,VR,WQ,PQ,PHIR2OUTP0670
4            ,PHIRD2,RPHRD,GCTH,GSTH,GCTSP,GCTCP,XXX,YYY,IX,IY,XX1,OUTP0680
5             XX2,YY1,YY2,THG1,THG2,PHG1,PHG2,ZZ1,ZZ2,LLL                OUTP0690
 DIMENSION HCAH(4),HCBH(4),HCGH(4)                                       OUTP0700
 EQUIVALENCE (HCAH(1),HCAH1),(HCBH(1),HCBH1),(HCGH(1),HCGH1)             OUTP0710
 COMMON /COMPN/ FRSP(4),FRCP(4),ICBHIT,JCBHIT,                           OUTP0720
1               DPSINT,TANPC1,TANPC2,PHIC1R,PHIC2R,AMUCMP,PHI1D,         OUTP0730
2               PHI2D,LCB1(4),LCB2(4),IHIT,AJMTX(3,3),BMTX(3,3),         OUTP0740
3               SFRX(4),SFRY(4),SFRZ(4),T1PSI,T2PSI,XMUGI(4)             OUTP0750
 LOGICAL LCB1,LCB2                                                       OUTP0760
 COMMON /INTR/ NEQR,TIMR,DTR,VARR(12),DERR(12)                           OUTP0770
 DIMENSION RPSI(4),DRPSI(4)                                              OUTP0780
 EQUIVALENCE(VARR(1),RPSI(1)),(DERR(1),DRPSI(1))                         OUTP0790
 COMMON /INPT4/ FIDJ(2),FIWJ(2),ARBR(2),NXUGMU,NXFRCP,XXUGMU(6),         OUTP0800
A               XXFRCP(6),XMUMAT(6,6,4),XMXPMT(6,6,4),                   OUTP0810
B               XMXSMT(6,6,4),SLIPMT(6,6,4),CT(4),XMUM(4),               OUTP0820
C               XMUXP(4),XMUXS(4),RRMC(4),RRM(4),COMEN4                  OUTP0830
 EQUIVALENCE (FIDJ(1),FIDJF),(FIDJ(2),FIDJR),(FIWJ(1),FIWJF)             OUTP0840
 EQUIVALENCE (FIWJ(2),FIWJR),(ARBR(1),ARBRF),(ARBR(2),ARBRR)             OUTP0850
 COMMON /COMP4/FIDAR(2),FIDIW(2),FIDWR2(2),SPHICI(4),CPHICI(4),          OUTP0860
1               TIHI(4),ARBRI(4), PSITEM(4),SLPFAC(4),DTSTEP,DTTEST,OUTP0870
2        DTINT,TWOPIR,FRTEST(4),XMUI(4),FRCPMU(4),HRTERM,SLIP(4),        OUTP0880
3               SLIPT(4),RHOS(4),EPSS(4),TERMP(4),TERMB(4),TERM(4),      OUTP0890
4               EPSSFC,FSXFAC(4),FSYFAC(4),FSZFAC(4),FRXFAC(4),          OUTP0900
5               FRYFAC(4),FRZFAC(4),FCXFAC(4),FCYFAC(4),FCZFAC(4),       OUTP0910
6               SFCDTR(4),SFSDTR(4),SFRCPR(4),SSLIP(4),FCAV(4),          OUTP0920
7               FSAV(4),FRCPAV(4),SLIPAV(4),RPSSM(4),FCSLSM(4),          OUTP0930
8          ARTQ6(4),TQFAC(4),ARFAC1(2),ARFAC2(2),RPSFA(2),RPSFB(2),OUTP0940
9          RPSFC(2),RPSFD(2),HRPSFA(4),HRPSFB(4),HRPSFC(4),STEPD         OUTP0950
 COMMON /COMP4/  XBRAK(16),IUVS(4),IUVB(4),IRPS,IDTCNT,ISTEP,ISTOP OUTP0960
 LOGICAL  IUVS,IUVB,IRPS                                                 OUTP0970
 COMMON/COMP5/ TAU(4),TQD(2),TQB(4),PP(2),TLAMB(2),PC,RWDRIV,JDEND,OUTP0980
1               NBTYP,ARFAC3(2),RPSFE(2),RHOSMX(3),SLIPMX(3),SLIPP,      OUTP0990
2               RHOMAX,RHOSAV(4),SRHOS(4),UGW(4),ABSUGW(4),VECS,         OUTP1000
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     3              DELTAE,PIO15R,COMEN5,TQE,RPME
      COMMON/ADTNL/ U1,U2,U3,U4,V1,V2,V3,V4,W1,W2,W3,W4,
     1              XIYP,SPHIC,CPHIC,APTCH1,APTCH2,APTCH3,APTCH4,
     2              SLOPE1,SLOPE2,XTRA(300)
      DIMENSION UI(4),VI(4),WI(4)
      EQUIVALENCE (UI(1),U1),(VI(1),V1),(WI(1),W1)
      DIMENSION APITCH(4)
      EQUIVALENCE (APITCH(1),APTCH1)
      COMMON /INSUS/ XIF,RHOF,TSF,PHIFO,PHIFOD,DEL40,DEL40D,ISUS,
     1               AKDS,AKDS1,AKDS2,AKDS3,PHIRC(50),DTHF(50),DTHR(50),
     2               NCAMF,NCAMR,NDTHF,NDTHR
      COMMON /SUSCMP/ XMURO2,BXMRO2,XMTRO4,ZFO,TSFO2,RHOF2,RHFMUF,
     1                RHF2MF,RF2MFI,RTF,RRTR,D3PD4,D3MD4,D43,DD3P4,
     2                DD3M4,ZFD1RF,ZRD34,RFPF,RPF2M,WFMF,PHFP,PHIF2,
     3                PHIFD2,RPHFD,ZFD1,ZFD2,ZRD4,TPF,SLOPE3,SLOPE4,
     4                PHI3D,PHI4D,DTHF1,DTHF2,DTHR3,DTHR4,DTDD1,
     5                DTDD2,DTDD3,DTDD4,FJF(4),SNPF
      COMMON/DRIVE/EN,FKD,FKP,FKS1,FKS2,FKSKID,TESTE,TESTS1,TESTS2,
     1             TESTR1,TESTR2,THESKD,FBRK,APB,DSDES,
     2             TRKIN,TMT,DESS,DIST,DISTC,CONMPH,UT,UTMPH,
     3             APD,DELTAX,DELTV,TJ,TTEM,TTPSIT,PSISKD,ST,STSO2,GAY,
     4             AXP,AYP,DI,UP,XVP,YVP,SLOPE,SLOPER,PSIJ,XINT,X,Y,
     5             TERMX,TERMY,TEMPOR,AE,EI,EWT,AREI(7),ARCAPE(7),ET,
     6             PSIFFH,TITE,DPSISF,DPSILF,PSIM,APSI,APSIM,TPD(10),
     7             PPD(10),NPD,KCOUNT,ISKIDP,ISMAIN,IGEAR,WEIGHT(10),
     8             DEND
      DIMENSION ASTR(4),SLPANG(4)
      DIMENSION OTQD(4),ORPS(4),OSLIP(4)
      DATA STAR,BLNK/1H*,1H /
      DATA LPP/50/
      DATA TTTTTT/-9999.0/
      IF(IND.NE.0) GO TO 400
      LINES = 0
      RETURN
  400 LINES = LINES+1
      IF(MOD(LINES,LPP).NE.1) GO TO 500
      XPAGE = 0.01*(LINES+LPP-1)/LPP
      NT = 10
      DO 410 J=1,20
      IF(NPAGE(J).EQ.0) GO TO 410
      NT = NT+1
      PAGE = NT+XPAGE
      WRITE(NT,1000) (HED(I),I=1,18),DADE(1),DADE(2),
     1     (VHED(I),I=1,10),(THED(I),I=1,10),(CHED(I),I=1,10),
     2      (GHED(I),I=1,10),(SHED(I),I=1,10),PAGE
 1000 FORMAT(1H1,19X,18A4,20X,2A4 / 5X,3(10A4) / 5X,2(10A4),
     1        22X,4HPAGE,1X,F8.2  /  )
      GO TO(111,112,113,114,115,116,117,118,119,120,121,122,123,124,
     *      125,126,127,128,129,130),J
C  POSSIBLE ERROR MESSAGE
      GO TO 410
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 111 WRITE(NT,1100)
1100 FORMAT(1H0,48X,23HS P R U N G     M A S S   /
    A62H  TIME    |          POSITION (FEET)            |      VELOCITY (
    B62HFT/SEC)             |               ACCELERATION (G-UNITS)
    C 6H      |   /
    D62H   SEC    |      XC'    |      YC'    |      ZC'    | FORWARD   |  LA
    E62HTERAL  |  VERTICAL |    LONG.  |     LAT.  |     VERT.   |  RESU
    F 6HLT.   |   /)
     GO TO 410
 112 IF(ISUS.EQ.1) GO TO 1121
     WRITE(NT,1200)
1200 FORMAT(
    A62H0         |                             S P R U N G   M A S S
    B62H                    |  SIDESLIP |    COURSE |FRONT STEER| REAR
    C 6HSTEER|  /
    D62H  TIME    |   ANGULAR VELOCITIES (DEG/SEC)      |       ORIENTATIO
    E62HN (DEGREES)         |     ANGLE  |     ANGLE  |     ANGLE  |     AN
    F 6HGLE   |  /
    G62H   SEC    |      P      |      Q      |      R      |    ROLL    |    P
    H62HITCH    |     YAW    |      DEG    |      DEG    |      DEG    |     D
    I 6HEG    |  /)
     GO TO 410
1121 WRITE(NT,1201)
1201 FORMAT(
    A62H0         |                             S P R U N G   M A S S
    B62H                    |  SIDESLIP |    COURSE |FR.STEER|RR STEER|
    C 9HLR STEER|  /
    D62H  TIME    |   ANGULAR VELOCITIES (DEG/SEC)      |       ORIENTATIO
    E62HN (DEGREES)         |     ANGLE  |     ANGLE  |  ANGLE |  ANGLE |
    F 9H  ANGLE |  /
    G62H   SEC    |      P      |      Q      |      R      |    ROLL    |    P
    H62HITCH    |     YAW    |      DEG    |      DEG    |   DEG  |   DEG  |
    I 9H   DEG  |  /   )
     GO TO 410
 113 WRITE(NT,1300)
1300 FORMAT(
    A62H0 TIME    |        WHEEL RIDE DISPLACEMENTS (INCHES)         |
    B44H      WHEEL RIDE VELOCITIES (IN/SEC)          |   /
    C62H    SEC    |       RF     |      LF     |       RR     |       LR    |
    D44H  RF    |      LF     |      RR     |      LR    |   /)
     GO TO 410
 114 GO TO(1140,1141,1142),IS1
1140 WRITE(NT,1400)
1400 FORMAT(55H0             |               SPRUNG MASS               |   WHEEL
    A62HRIDE ACCEL   |     REAR ROLL CENTER RIDE          |       REAR AXLE A
    B15HNGULAR           |  /
    C62H  TIME    | ANGULAR ACCELERATIONS (DEG/SEC**2)|    (IN/SEC**2)
    D62H          | DEFL    | VELOCITY |ACCELERATION|  DEFL    | VELOCITY |  A
    E 9HCCEL    |   /
    F62H   SEC    |     DP/DT |      DQ/DT |      DR/DT |       RF   |
    G62H LF   | INCHES |    IN/SEC | IN/SEC**2   |    DEG   |  DEG/SEC |DEG
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     H 8H/SEC**2|   /)
      GO TO 410
 1141 WRITE(NT,1401)
 1401 FORMAT(1H0,
     A62H          |         SPRUNG MASS             |       WHEEL RIDE ACCE
     B14HL            | /
     C62H   TIME    | ANGULAR ACCEL. (DEG/SEC**2) |          (IN/SEC**2)
     D15H              | /
     E62H    SEC    |   DP/DT |   DQ/DT |   DR/DT |      RF |     LF |
     F15H  RR |      LR | / )
      GO TO 410
 1142 WRITE(NT,1402)
 1402 FORMAT(
     A62H0          |         SPRUNG MASS            |    FRONT ROLL CENTER
     B62H      |      REAR ROLL CENTER      | FR. AXLE ANGULAR|REAR AXLE A
     C 7HNGULAR|   /
     D62H   TIME    | ANGULAR ACCEL. (DEG/SEC**2) |  DEFL  |VELOCITY|  A
     E62HCCEL |  DEFL  |VELOCITY|  ACCEL |VELOCITY|  ACCEL |VELOCITY|
     F 7HACCEL |   /
     G62H    SEC    |   DP/DT |   DQ/DT |   DR/DT | INCHES | IN/SEC | IN
     H62H/SEC2| INCHES | IN/SEC | IN/SEC2| DEG/SEC|DEG/SEC2| DEG/SEC|DE
     I 7HG/SEC2|   /    )
      GO TO 410
  115 WRITE(NT,1500)
 1500 FORMAT(1H0,8X,48H| STEER FRIC| STEER STOP|    STEER  |    STEER
     A 1H|  /
     B59H  TIME    |   TORQUE   |   TORQUE   |      VEL    |     ACCEL   |  /
     C59H   SEC    |    LB-IN   |    LB-IN   |   DEG/SEC  | DEG/SEC**2|  /)
      GO TO 410
  116 GO TO(1160,1161,1162),IS1
 1160 WRITE(NT,1600)
 1600 FORMAT(
     A62H0 TIME    |    STEER ANGLE IN GROUND PLANE (DEG)            |   C
     B62HAMBER ANGLE RELATIVE TO GROUND PLANE (DEG) |  CAMBER ANGLE (DE
     C 6HG)    |   /
     D62H   SEC    |      RF    |      LF    |      RR    |      LR    |
     E62H   RF    |      LF    |      RR    |      LR    |      RF    |
     F 6HLF    |   /)
      GO TO 410
 1161 WRITE(NT,1601)
 1601 FORMAT(
     A62H0 TIME    |    STEER ANGLE IN GROUND PLANE (DEG)            |   C
     B62HAMBER ANGLE RELATIVE TO GROUND PLANE (DEG) |    CAMBER ANGLE (
     C 9HDEG)    |   /
     D62H   SEC    |      RF    |      LF    |      RR    |      LR    |
     E62H  RF    |      LF    |      RR    |      LR    |  RF |   LF |    R
     F 9HR |  LR |   /  )
      GO TO 410
 1162 WRITE(NT,1602)
 1602 FORMAT(
     A62H0 TIME    |    STEER ANGLE IN GROUND PLANE (DEG)            |   C
```

```
    B62HAMBER ANGLE RELATIVE TO GROUND PLANE (DEG) | AXLE ROLL ANGLE ( OUTP2540
    C 6HDEG) |    /                                                    OUTP2550
    D62H   SEC    |      RF    |.     LF    |      RR    |      LR    |  OUTP2560
    E62H  RF    |      LF    |      RR    |      LR    | FRONT-PHIF| REAR- OUTP2570
    F 6HPHIR |    / )                                                 OUTP2580
     GO TO 410                                                        OUTP2590
 117 WRITE(NT,1700)                                                   OUTP2600
1700 FORMAT(                                                          OUTP2610
    A62HO          |     LONGITUDINAL WHEEL CENTER VELOCITY          |  OUTP2620
    B44H    LATERAL CONTACT POINT VELOCITY          |    /            OUTP2630
    C62H  TIME    |       PARALLEL TO GROUND PLANE (FT/SEC)          |  OUTP2640
    D44H   PARALLEL TO GROUND PLANE (FT/SEC)        |    /            OUTP2650
    E62H   SEC    |      RF    |      LF    |      RR    |      LR    |  OUTP2660
    F44H  RF    |      LF    |      RR    |      LR    |    /)         OUTP2670
     GO TO 410                                                        OUTP2680
 118 WRITE(NT,1800)                                                   OUTP2690
1800 FORMAT(                                                          OUTP2700
    A58HO TIME    |   TIRE CONTACT POINT ELEVATION (INCHES)       | /  OUTP2710
    B58H   SEC    |      RF    |      LF    |      RR    |      LR    | /) OUTP2720
     GO TO 410                                                        OUTP2730
 119 WRITE(NT,1900)                                                   OUTP2740
1900 FORMAT(                                                          OUTP2750
    A62HO TIME    |          TOTAL SUSPENSION FORCE (LBS)            |  OUTP2760
    B44H      SUSPENSION ANTI-PITCH FORCE (LBS)      |    /           OUTP2770
    C62H   SEC    |      RF    |      LF    |      RR    |      LR    |  OUTP2780
    D44H  RF    |      LF    |      RR    |      LR    |    /)         OUTP2790
     GO TO 410                                                        OUTP2800
 120 WRITE(NT,2000)                                                   OUTP2810
2000 FORMAT(                                                          OUTP2820
    A62HO TIME    |        SUSPENSION DAMPING FORCE (LBS)            |  OUTP2830
    B44H        SUSPENSION SPRING FORCE (LBS)        |      /         OUTP2840
    C62H   SEC    |      RF    |      LF    |      RR    |      LR    |  OUTP2850
    D44H  RF    |      LF    |      RR    |      LR    |    /)         OUTP2860
     GO TO 410                                                        OUTP2870
 121 WRITE(NT,2100)                                                   OUTP2880
2100 FORMAT(                                                          OUTP2890
    A62HO TIME    |          RADIAL TIRE FORCES (LBS)                |  OUTP2900
    B44H        ROLLING RADIUS (INCHES)              |   /            OUTP2910
    C62H   SEC    |      RF    |      LF    |      RR    |      LR    |  OUTP2920
    D44H  RF    |      LF    |      RR    |      LR    |   /)          OUTP2930
     GO TO 410                                                        OUTP2940
 122 WRITE(NT,2200)                                                   OUTP2950
2200 FORMAT(                                                          OUTP2960
    A62HO TIME    |          TIRE NORMAL FORCE (LBS)          |         OUTP2970
    B62H TIRE SIDE FORCE (LBS)             |           SLIP ANGLE (DEG) OUTP2980
    C 6H      |    /                                                  OUTP2990
    D62H  SEC     |      RF  |      LF  |      RR  |      LR  |      RF OUTP3000
    E62H  |      LF  |      RR  |      LR  |  RF  |  LF  |  RR  |      OUTP3010
    F 6H LR  |    /)                                                  OUTP3020
     GO TO 410                                                        OUTP3030
 123 WRITE(NT,2300)                                                   OUTP3040
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2300 FORMAT(1H0,105X,25H|  ENGINE    | ENGINE    |   /                    OUTP3050
    A62H  TIME    |         TIRE TRACTIVE FORCE (LBS)              |        OUTP3060
    B62H             DRIVING TORQUE (LB-FT)           |    SPEED  |    TO OUTP3070
    C 6HRQUE |    /                                                        OUTP3080
    D62H   SEC    |      RF    |      LF    |      RR    |      LR    |     OUTP3090
    E62H  RF    |     LF    |      RR    |      LR    |     RPM    |     F OUTP3100
    F 6HT-LB |    /     )                                                  OUTP3110
     GO TO 410                                                             OUTP3120
 124 WRITE(NT,2400)                                                        OUTP3130
2400 FORMAT(                                                               OUTP3140
    A62H0 TIME    |   Z'-VERTICAL TIRE FORCE (LBS)         |   X'-HORIZO OUTP3150
    B62HNTAL TIRE FORCE (LBS)       |   Y'-HORIZONTAL TIRE FORCE (LBS)    OUTP3160
    C 6H      |    /                                                       OUTP3170
    D62H   SEC    |    RF    |    LF    |    RR    |    LR    |    RF    |  OUTP3180
    E62H  LF    |    RR    |    LR    |    RF    |    LF    |    RR    |    OUTP3190
    F 6HLR    |    /)                                                      OUTP3200
     GO TO 410                                                             OUTP3210
 125 WRITE(NT,2500)                                                        OUTP3220
2500 FORMAT(                                                               OUTP3230
    A62H0 TIME    |        TERRAIN ELEVATION (IN)         |   TERRAIN S OUTP3240
    B62HLOPE-CAMBER (PHIG) (DEG)    |   TERRAIN SLOPE-PITCH (THETAG) (D OUTP3250
    C 6HEG)  |    /                                                        OUTP3260
    D62H   SEC    |    RF    |    LF    |    RR    |    LR    |    RF    |  OUTP3270
    E62H  LF    |    RR    |   LR    |    RF    |    LF    |    RR    |     OUTP3280
    F 6HLR    |    /)                                                      OUTP3290
     GO TO 410                                                             OUTP3300
 126 WRITE(NT,2600)                                                        OUTP3310
2600 FORMAT(                                                               OUTP3320
    A62H0 TIME    | SPRUNG MASS ACCELERATION LOCATION 1(G-UNITS)  | SPR OUTP3330
    B44HUNG MASS ACCELERATION LOCATION 2 (G-UNITS) |      /                OUTP3340
    C62H   SEC    |   LONG.    |    LAT.    |   VERT.    |  RESULT. |   L OUTP3350
    D44HONG.    |    LAT.    |   VERT.    |   RESULT. |      /)            OUTP3360
     GO TO 410                                                             OUTP3370
 127 WRITE(NT,2700)                                                        OUTP3380
2700 FORMAT(                                                               OUTP3390
    A62H0 TIME     |          WHEEL SLIP (PERCENT)          |              OUTP3400
    B62H FRICTION RATIO               |         WHEEL ROTATION (REV/SEC)   OUTP3410
    C 6H      |    /                                                       OUTP3420
    D62H   SEC    |    RF    |    LF    |    RR    |    LR    |    RF    |  OUTP3430
    E62H  LF    |    RR    |    LR    |    RF    |    LF    |    RR    |    OUTP3440
    F 6HLR    |    /     )                                                 OUTP3450
     GO TO 410                                                             OUTP3460
 128 WRITE(NT,2800)                                                        OUTP3470
2800 FORMAT(                                                               OUTP3480
    A62H0         |   HYDRAULIC PRES.      |                  BRAKE TORQU OUTP3490
    B62HES                |                 BRAKE TEMPERATURE              OUTP3500
    C 6H      |    /                                                       OUTP3510
    D62H  TIME    |        (PSIG)        |                       (LB-FT)  OUTP3520
    E62H                  |                     (DEG-F)                    OUTP3530
    F 6H      |    /                                                       OUTP3540
    G62H   SEC    |   FRONT    |    REAR    |      RF    |      LF    |     OUTP3550
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```
     H62H  RR    |       LR    |       RF    |       LF    |       RR    |
     I 6HLR    |    /    )
      GO TO 410
  129 WRITE(NT,2900)
 2900 FORMAT(
     A62HO        |                                      DISSIPATED ENERGY
     B44H(FT-LB)                                       |     /
     C62H  TIME    |                     BRAKES                          |
     D44H                 TIRES                        |     /
     E62H   SEC    |       RF    |       LR    |       RR    |       LR    |
     F44H  RF    |       LF    |       RR    |       LR    |     /     )
      GO TO 410
  130 WRITE(NT,3000)
 3000 FORMAT(
     A62HO TIME    | DELTA PSIF| ERROR ETJ |   DESIRED |   ACC PED | BRA
     B15HKE PED |        |    /
     C62H   SEC    |       DEG   |       IN.   |    ACCEL   |      DEFL   |
     D15HFORCE   | GEAR |    /
     E62H          |             |             |  IN/SEC**2|      IN.   |
     F15H  LBS   |        |    /    )
  410 CONTINUE
  500 NT = 10
      DO 600 J=1,20
      IF(NPAGE(J).EQ.0) GO TO 600
      GO TO (11,12,13,14,15,16,17,18,19,20,21,22,23,24,25,26,27,
     *     28,29,30),J
   11 NT = NT+1
      ACLON = (DU-VR+WQ)/G
      ACLAT = (DV+UR-WP)/G
      ACVER = (DW+VP-UQ)/G
      ULON = U/12.
      VLAT = V/12.
      WVER = W/12.
      ACRES = SQRT(ACLON**2+ACLAT**2+ACVER**2)
      OXCP = XCP/12.
      OYCP = YCP/12.
      OZCP = ZCP/12.
      WRITE(NT,5000) T,OXCP,OYCP,OZCP,ULON,VLAT,WVER,ACLON,ACLAT,ACVER,
     *               ACRES
 5000 FORMAT(' ',F7.4,10(2X,F10.2))
      GO TO 600
   12 NT = NT+1
      ONU = 0.0
      IF(DYCP.EQ.0.0.AND.DXCP.EQ.0.0) GO TO 212
      ONU = ATAN2(DYCP,DXCP)/RAD
  212 ROLL = P/RAD
      PITCH = Q/RAD
      YAW = R/RAD
      PHIO = PHIT/RAD
      THTAO = THETT/RAD
      PSIO = PSIT/RAD
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      OBETA = ONU-PSIO                                                  OUTP4070
      PSIFO = PSI1/RAD                                                  OUTP4080
      IF(ISUS.EQ.1) GO TO 213                                           OUTP4090
      OPSIR = PSI3/RAD                                                  OUTP4100
      WRITE(NT,5000) T,ROLL,PITCH,YAW,PHIO,THTAO,PSIO,OBETA,ONU,PSIFO,  OUTP4110
     *               OPSIR                                              OUTP4120
      GO TO 600                                                         OUTP4130
  213 OPSI3 = PSI3/RAD                                                  OUTP4140
      OPSI4 = PSI4/RAD                                                  OUTP4150
      WRITE(NT,5004) T,ROLL,PITCH,YAW,PHIO,THTAO,PSIO,OBETA,ONU,PSIFO,  OUTP4160
     *               OPSI3,OPSI4                                        OUTP4170
      GO TO 600                                                         OUTP4180
   13 NT = NT+1                                                         OUTP4190
      GO TO(131,132,133),IS1                                            OUTP4200
  131 OETA3 = DEL3+TRO2*PHIR                                            OUTP4210
      OETA3 = DEL3+TRO2*PHIR                                            OUTP4220
      OETA4 = DEL3-TRO2*PHIR                                            OUTP4230
      OETA3D = DEL3D+TRO2*PHIRD                                         OUTP4240
      OETA4D = DEL3D-TRO2*PHIRD                                         OUTP4250
      WRITE(NT,5000) T,DEL1,DEL2,OETA3,OETA4,DEL1D,DEL2D,OETA3D,OETA4D  OUTP4260
      GO TO 600                                                         OUTP4270
  132 WRITE(NT,5000) T,DEL1,DEL2,DEL3,DEL4,DEL1D,DEL2D,DEL3D,DEL4D      OUTP4280
      GO TO 600                                                         OUTP4290
 5004 FORMAT(1H ,F7.4,8(2X,F10.2),3(2X,F7.2) )                          OUTP4300
  133 OETA1 = DEL1+TFO2*PHIF                                            OUTP4310
      OETA2 = DEL1-TFO2*PHIF                                            OUTP4320
      OETA3 = DEL3+TRO2*PHIR                                            OUTP4330
      OETA4 = DEL3-TRO2*PHIR                                            OUTP4340
      OETA1D = DEL1D+TFO2*PHIFD                                         OUTP4350
      OETA2D = DEL1D-TFO2*PHIFD                                         OUTP4360
      OETA3D = DEL3D+TRO2*PHIRD                                         OUTP4370
      OETA4D = DEL3D-TRO2*PHIRD                                         OUTP4380
      WRITE(NT,5000) T,OETA1,OETA2,OETA3,OETA4,OETA1D,OETA2D,OETA3D,    OUTP4390
     *               OETA4D                                             OUTP4400
      GO TO 600                                                         OUTP4410
   14 NT = NT+1                                                         OUTP4420
      ODP = DP/RAD                                                      OUTP4430
      ODQ = DQ/RAD                                                      OUTP4440
      ODR = DR/RAD                                                      OUTP4450
      IF(ISUS.EQ.1) GO TO 141                                           OUTP4460
      OPHDTO = PHIRD/RAD                                                OUTP4470
      OPHDD = DPHIRD/RAD                                                OUTP4480
      IF(ISUS.EQ.2) GO TO 142                                           OUTP4490
      PHIRO = PHIR/RAD                                                  OUTP4500
      WRITE(NT,5001) T,ODP,ODQ,ODR,DDEL1D,DDEL2D,DEL3,DEL3D,DDEL3D,     OUTP4510
     *               PHIRO,OPHDTO,OPHDD                                 OUTP4520
 5001 FORMAT(' ',F7.4,3(2X,F10.2),2(2X,F9.1),2X,F7.2,2X,F9.1,2X,        OUTP4530
     *       F9.1,2X,F7.2,2X,F9.1,2X,F9.1 )                             OUTP4540
      GO TO 600                                                         OUTP4550
  141 WRITE(NT,5005) T,ODP,ODQ,ODR,DDEL1D,DDEL2D,DDEL3D,DDEL4D          OUTP4560
 5005 FORMAT(1H ,F7.3,3(2X,F8.2),10(2X,F7.1) )                          OUTP4570
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      GO TO 600
  142 DPFDTO = PHIFD/RAD
      OPFDD = DPHIFD/RAD
      WRITE(NT,5005) T,ODP,ODQ,ODR,DEL1,DEL1D,DDEL1D,DEL3,DEL3D,DDEL3D,
     *                DPFDTO,OPFDD,DPHDTO,OPHDD
      GO TO 600
   15 NT = NT+1
      ODPSF1 = DPSIFI/RAD
      ODDPSF = DDPSFI/RAD
      WRITE(NT,5000) T,T1PSI,T2PSI,ODPSFI,ODDPSF
      GO TO 600
   16 NT = NT+1
      PHRF = PHICI(1)/RAD
      PHLF = PHICI(2)/RAD
      PHRR = PHICI(3)/RAD
      PHLR = PHICI(4)/RAD
      PSRF = PSIIP(1)/RAD
      PSLF = PSIIP(2)/RAD
      PSRR = PSIIP(3)/RAD
      PSLR = PSIIP(4)/RAD
      IF(ISUS.EQ.2) GO TO 162
      PHI10 = PHI1/RAD
      PHI20 = PHI2/RAD
      IF(ISUS.EQ.1) GO TO 161
      WRITE(NT,5000) T,PSRF,PSLF,PSRR,PSLR,PHRF,PHLF,PHRR,PHLR,PHI10,
     *                PHI20
      GO TO 600
  161 PHI30 = PHI3/RAD
      PHI40 = PHI4/RAD
      WRITE(NT,5006) T,PSRF,PSLF,PSRR,PSLR,PHRF,PHLF,PHRR,PHLR,PHI10,
     *                PHI20,PHI30,PHI40
      GO TO 600
  162 PHIFO = PHIF/RAD
      PHIRO = PHIR/RAD
      WRITE(NT,5000) T,PSRF,PSLF,PSRR,PSLR,PHRF,PHLF,PHRR,PHLR,PHIFO,
     *                PHIRO
 5006 FORMAT(1H ,F7.4,8(2X,F10.2),4(1X,F6.2) )
      GO TO 600
   17 NT = NT+1
      VLNRF = UG(1)/12.
      VLNLF = UG(2)/12.
      VLNRR = UG(3)/12.
      VLNLR = UG(4)/12.
      VLTRF = VG(1)/12.
      VLTLF = VG(2)/12.
      VLTRR = VG(3)/12.
      VLTLR = VG(4)/12.
      WRITE(NT,5000) T,VLNRF,VLNLF,VLNRR,VLNLR,VLTRF,VLTLF,VLTRR,VLTLR
      GO TO 600
   18 NT = NT+1
      WRITE(NT,5000) T,(ZGPP(I),I=1,4)
```

```
      GO TO 600
   19 NT = NT+1
      WRITE(NT,5000) T,(SI(I),I=1,4),(APITCH(I),I=1,4)
      GO TO 600
   20 NT = NT+1
      IF(ISUS.EQ.2) GO TO 201
      OD1 = -CF*DEL1D
      OD2 = -CF*DEL2D
      GO TO 202
  201 OD1 = -CF*(DEL1D+TSF02*PHIFD)
      OD2 = -CF*(DEL1D-TSF02*PHIFD)
  202 IF(ISUS.EQ.1) GO TO 203
      OD3 = -CR*(DEL3D+TS02*PHIRD)
      OD4 = -CR*(DEL3D-TS02*PHIRD)
      GO TO 204
  203 OD3 = -CR*DEL3D
      OD4 = -CR*DEL4D
  204 CONTINUE
      OSP1 = -F2FI(1)
      OSP2 = -F2FI(2)
      OSP3 = -F2RI(1)
      OSP4 = -F2RI(2)
      WRITE(NT,5000) T,OD1,OD2,OD3,OD4,OSP1,OSP2,OSP3,OSP4
      GO TO 600
   21 NT = NT+1
      WRITE(NT,5000) T,(FR(I),I=1,4),(HI(I),I=1,4)
      GO TO 600
   22 NT = NT+1
      DO 220 I=1,4
      ASTR(I) = BLNK
      IF(ABS(BETBR(I)).GT.3.0) ASTR(I)=STAR
      SLPANG(I) = (TERM(I)-PSITEM(I))/RAD
  220 CONTINUE
      WRITE(NT,5003) T,(FRCP(I),I=1,4),(FS(I),ASTR(I),I=1,4),
     *               (SLPANG(I),I=1,4)
 5003 FORMAT(1H ,F7.4,1X,4(1X,F10.2),4(1X,F9.2,A1),4(1X,F7.2)    )
      GO TO 600
   23 NT = NT+1
      OTQD(1) = 0.5*TQD(1)*ARBR(1)
      OTQD(2) = OTQD(1)
      OTQD(3) = 0.5*TQD(2)*ARBR(2)
      OTQD(4) = OTQD(3)
      WRITE(NT,5000) T,(FC(I),I=1,4),(OTQD(I),I=1,4),RPME,TQE
      GO TO 600
   24 NT = NT+1
      FR1O = AMTX(3,1)*FXU(1)+AMTX(3,2)*FYU(1)+AMTX(3,3)*FZU(1)
      FR2O = AMTX(3,1)*FXU(2)+AMTX(3,2)*FYU(2)+AMTX(3,3)*FZU(2)
      FR3O = AMTX(3,1)*FXU(3)+AMTX(3,2)*FYU(3)+AMTX(3,3)*FZU(3)
      FR4O = AMTX(3,1)*FXU(4)+AMTX(3,2)*FYU(4)+AMTX(3,3)*FZU(4)
      FXPU1 = AMTX(1,1)*FXU(1)+AMTX(1,2)*FYU(1)+AMTX(1,3)*FZU(1)
      FXPU2 = AMTX(1,1)*FXU(2)+AMTX(1,2)*FYU(2)+AMTX(1,3)*FZU(2)
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      FXPU3 = AMTX(1,1)*FXU(3)+AMTX(1,2)*FYU(3)+AMTX(1,3)*FZU(3)
      FXPU4 = AMTX(1,1)*FXU(4)+AMTX(1,2)*FYU(4)+AMTX(1,3)*FZU(4)
      FYPU1 = AMTX(2,1)*FXU(1)+AMTX(2,2)*FYU(1)+AMTX(2,3)*FZU(1)
      FYPU2 = AMTX(2,1)*FXU(2)+AMTX(2,2)*FYU(2)+AMTX(2,3)*FZU(2)
      FYPU3 = AMTX(2,1)*FXU(3)+AMTX(2,2)*FYU(3)+AMTX(2,3)*FZU(3)
      FYPU4 = AMTX(2,1)*FXU(4)+AMTX(2,2)*FYU(4)+AMTX(2,3)*FZU(4)
      WRITE(NT,5002) T,FR10,FR20,FR30,FR40,FXPU1,FXPU2,FXPU3,FXPU4,
     *               FYPU1,FYPU2,FYPU3,FYPU4
 5002 FORMAT(' ',F7.4,12(2X,F8.1) )
      GO TO 600
   25 NT = NT+1
      PHG10 = PHGI(1)/RAD
      PHG20 = PHGI(2)/RAD
      PHG30 = PHGI(3)/RAD
      PHG40 = PHGI(4)/RAD
      THG10 = THGI(1)/RAD
      THG20 = THGI(2)/RAD
      THG30 = THGI(3)/RAD
      THG40 = THGI(4)/RAD
      WRITE(NT,5002) T,(ZPGI(I),I=1,4),PHG10,PHG20,PHG30,PHG40,THG10,
     *               THG20,THG30,THG40
      GO TO 600
   26 NT = NT+1
      AX1 = (DU-VR+WQ-X1*(Q2+R2)+Y1*(PQ-DR)+Z1*(PR+DQ))/G
      AX2 = (DU-VR+WQ-X2*(Q2+R2)+Y2*(PQ-DR)+Z2*(PR+DQ))/G
      AY1 = (DV+UR-WP+X1*(PQ+DR)-Y1*(P2+R2)+Z1*(QR-DP))/G
      AY2 = (DV+UR-WP+X2*(PQ+DR)-Y2*(P2+R2)+Z2*(QR-DP))/G
      AZ1 = (DW+VP-UQ+X1*(PR-DQ)+Y1*(QR+DP)-Z1*(P2+Q2))/G
      AZ2 = (DW+VP-UQ+X2*(PR-DQ)+Y2*(QR+DP)-Z2*(P2+Q2))/G
      A1R = SQRT(AX1**2+AY1**2+AZ1**2)
      A2R = SQRT(AX2**2+AY2**2+AZ2**2)
      WRITE(NT,5000) T,AX1,AY1,AZ1,A1R,AX2,AY2,AZ2,A2R
      GO TO 600
   27 NT = NT+1
      DO 271 I=1,4
      ORPS(I) = RPSI(I)*TWOPIR
  271 OSLIP(I) = SLIPAV(I)*100.0
      WRITE(NT,5007) T,(OSLIP(I),I=1,4),(RHOSAV(I),I=1,4),
     1               (ORPS(I),I=1,4)
 5007 FORMAT(1H ,F7.4,8(2X,F8.3),4(2X,F8.2) )
      GO TO 600
   28 NT = NT+1
      WRITE(NT,5000) T,PP(1),PP(2),(TQB(I),I=1,4),(TAU(I),I=1,4)
      GO TO 600
   29 NT = NT+1
      WRITE(NT,5000) T,(RPSSM(I),I=1,4),(FCSLSM(I),I=1,4)
      GO TO 600
   30 NT = NT+1
      DPSSO = DPSISF/RAD
      WRITE(NT,5008) T,DPSSO,ET,DELTAX,APD,FBRK,IGEAR
 5008 FORMAT(1H ,F7.3,5(2X,F10.2),I4  )
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600 CONTINUE                                                          OUTP6110
    RETURN                                                            OUTP6120
    ENTRY THPLOT(IPLT)                                                OUTP6130
    GO TO(901,902,903),IPLT                                           OUTP6140
901 WRITE(3) HED,VHED,THED,CHED,GHED,SHED,DADE                        OUTP6150
    RETURN                                                            OUTP6160
902 WRITE(3) T,ULON,VLAT,ACLON,ACLAT,ACVER,ACRES,ROLL,PITCH,          OUTP6170
   1       YAW,PHIO,THTAO,PSIO,AX1,AY1,AZ1,A1R,AX2,AY2,AZ2,A2R         OUTP6180
    RETURN                                                            OUTP6190
903 WRITE(3) (TTTTTT,I=1,21)                                          OUTP6200
    RETURN                                                            OUTP6210
    END                                                               OUTP6220
```

```
      FUNCTION PARI(NN,IA,TSEC,X,Y)
C            HVOSM-VD2 VERSION
C            REVISED OCTOBER 1975   CALSPAN CORPORATION
      DIMENSION X(51), Y(51)
      PARI = 0.0
      N = NN
      XX = TSEC
      J = IA
      JA = J+1
      JB = J+2
    5 IF(JB.LE.N) GO TO 10
      J = N
      JA = N-1
      JB = N-2
   10 XA = X(J)
      XB = X(JA)
      XC = X(JB)
      YA = Y(J)
      YB = Y(JA)
   15 YC = Y(JB)
      D1 = (YB-YA)/(XB-XA)
      D2 = (YC-YB)/(XC-XB)
      D3 = (D2-D1)/(XC-XA)
      PARI = YA + (XX-XA) * (D1 + D3 * (XX-XB))
      RETURN
      END
```

```
      SUBROUTINE PINT1(IN,MODE,N,/X/,/HH/,YY,YYP,A)
C***********************************************************************
C*                                                                     *
C*    SUBROUTINE PINT1                                                 *
C*                                                                     *
C*    PURPOSE                                                          *
C*      TO SOLVE A SYSTEM OF N REAL ORDINARY DIFFERENTIAL EQUATIONS OF *
C*      THE FIRST ORDER                                                *
C*                                                                     *
C*    USAGE                                                            *
C*      CALL PINT1(IN,MODE,N,X,HH,YY,YYP,A)                            *
C*                                                                     *
C*    DESCRIPTION OF PARAMETERS                                        *
C*      N      NUMBER OF EQUATIONS                                     *
C*      IN     INDICATOR FOR INITIALIZATION OF INTEGRATION STEP , IF   *
C*             IN = 1 THE ROUTINE INITIALIZES                          *
C*             IN = 2 THE ROUTINE INTEGRATES ONE STEP                  *
C*      MODE   THE OPTION WORD(=0,1,OR 2) FOR USING ONE OF THE THREE MOD*
C*             ES OF INTEGRATION.   IF MODE EQUALS                     *
C*                0 - THE ADAMS-MOULTON VARIABLE STEP-SIZE IS USED,    *
C*                1 - THE RUNGE-KUTTA FIXED STEP-SIZE IS USED,         *
C*                2 - THE ADAMS FIXED STEP-SIZE IS USED                *
C*      A      IS AN ARRAY OF DIMENSION SIX CONTAINING THE PARAMETERS  *
C*                FOR THE VARIABLE MODE                                *
C*      X      THE SOURCE VARIABLE                                     *
C*      HH     THE INCREMENT IN SOURCE VARIABLE OR THE STEP SIZE       *
C*      YY     THE TARGET VARIABLES UPDATED BY THIS ROUTINE            *
C*      YYP    THE ARRAY OF FIRST DERIVATIVES OF THE TARGET VARIABLES  *
C*              COMPUTED IN  THE SUBROUTINE DAUX                       *
 1000 CONTINUE
C*   METHOD                                                            *
C*      THE ROUTINE USES THE E.K.BLUM MODIFICATION OF THE RUNGE-KUTTA  *
C*      FOURTH-ORDER METHOD,THE FOURTH ORDER ( FIXED AND VARIABLE )    *
C*      ADAMS-MOULTON PREDICTOR -CORRECTOR METHOD.                     *
C*                                                                     *
C*    REMARKS                                                          *
C*    BEFORE EXECUTING THE FIRST PINT1 CALL, THE USER MUST INITIALIZE  *
C*    X,HH, AND EACH OF THE TARGET VARIABLE.                           *
C*                                                                     *
C*      THE SECOND ENTRY POINT ( IN=2 ) MAY BE USED ANY NUMBER OF TIMES*
C*    AFTER THE FIRST PINT1 CALL (IN=1) TO INTEGRATE ONE STEP-SIZE.    *
C*                                                                     *
```

```
C*    SUBROUTINES REQUIRED                                              *
C*        ( ERRMSG ) NOT USED, SEE CARD SERIAL NUMBER05302840           *
C*      THE USER MUST PROVIDE A SUBROUTINE NAMED 'DAUX' WHICH EVALUATES*
C*      THE N DERIVATIVES OF THE SYSTEM OF N FIRST  ORDER DIFFERENIAL   *
C*      EQUATION                                                        *
C*                                                                      *
C*    AUTHOR                                                            *
C*       SQUARE PARTEE                                                  *
C*       AUGUST 1966                                                    *
C*       CORNELL AERONAUTICAL LAB.                                      *
C*                                                                      *
C***********************************************************************
      DIMENSION YY(1),YYP(1),A(1)
      DIMENSION Y(30),YNO(30),YN1(30),YN2(30),YN3(30),YPNO(30),YN(30),
     *          YPN(30),YPN1(30),YPN2(30),YPN3(30),P(30),Q(30)
      DOUBLE PRECISION H,DY,Y,YNO,YN,YN1,YN2,YN3,YPNO,YPN,YPN1,YPN2,
     *                  YPN3,DABS,P,Q
      EQUIVALENCE (YPNO(1),P(1))
      EQUIVALENCE (YNO(1),Q(1))
C
C     MODE=0      VARIABLE ADAMS MOULTON METHOD
C     MODE= 1       FIXED RUNGE-KUTTA
C     MODE= 2       FIXED ADAMS MOULTON METHOD
C
    1 INN = IN
      GO TO (2,50),INN
    2 NMODE = MODE + 1
      NDO = 1
      NGO = 1
      NSS = 1
    3 GO TO (8,50,5),NMODE
    5 NGO = 2
      GO TO 50
C
C     SET UP VARIABLE MODE PARAMETERS
C
    8 NGO = 3
      EMAX = ABS(A(1))
      IF (EMAX.EQ.0.0) EMAX = .1E-03
      EMIN = EMAX * .01
      IF (A(2).NE.0.0) EMIN = EMAX/ABS(A(2))
      AA = ABS(A(3))
      IF (AA.EQ.0.0) AA = 1.0
      HMAX = ABS(A(4))
      IF(HMAX.EQ.0.0) HMAX = 10.E+03
      HMIN = ABS(A(5))
      IF (HMIN.EQ.0.0)  HMIN = .1E-06
      BETA = ABS(A(6))
      IF (BETA.GE.1.0 .OR. BETA.LE.0.0) BETA = .5
      NMSG = 0
C
   50 GO  TO ( 100, 111, 200, 300    ) , NDO
C
C         FIXED RUNGE - KUTTA      INITIALIZATION
  100 DO 102  I=1,N
```

```
      Q(I) = 0.0
      Y(I) = YY(I)
  102 CONTINUE
      NSTEP = 0
  103 CALL  DAUX
  106 XOO = X
      H = HH
      IF (NGO.EQ.1) GO TO 110
  108 XN3 = X
      DO 109  I=1,N
      YPN3(I) = YYP(I)
      YN3(I) = YY(I)
  109 CONTINUE
  110 NDO = 2
      IF (   NSS .EQ. 1 )   RETURN
C
C              ONE  POINT  INTEGRATE
C
  111 XOO = X
      H = HH
      DO 112  I=1,N
      DY = YYP(I)
      P(I) = H*DY
      Y(I) = Y(I)+.5DO*P(I)
      Q(I) = P(I)
        YY(I)  = Y(I)
  112 CONTINUE
      X = XOO +  .5 * HH
      CALL  DAUX
  113 DO 115  I=1,N
      DY = YYP(I)
      P(I) = H*DY
      Y(I) = Y(I)+.5DO*P(I)-.5DO*Q(I)
      Q(I) = Q(I)/6.DO
        YY(I)  = Y(I)
  115 CONTINUE
  116 CALL  DAUX
  117 DO 120  I=1,N
      DY = YYP(I)
      P(I) = H*DY-.5DO*P(I)
      Y(I) = Y(I)+P(I)
      Q(I) = Q(I)-P(I)
        YY(I)  = Y(I)
  120 CONTINUE
      X = XOO  +  HH
      CALL  DAUX
  121 DO 125  I=1,N
      DY = YYP(I)
      P(I) = H*DY+2.0*P(I)
      Y(I) = Y(I) + Q(I)+P(I)/6.0DO
        YY(I)  = Y(I)
  125 CONTINUE
      CALL  DAUX
C
C           END OF FIXED STEP RUNGE - KUTTA
```

```
C
C
C
  130 IF  ( NGO   .EQ. 1   )     RETURN
  135 NSTEP = NSTEP + 1
      GO TO (136,140,145), NSTEP
C
C     SET UP THREE POINTS FOR ADAMS MOULTON'S
C
  136 XN2 = X
      DO 138  I=1,N
      YPN2(I)  =  YYP(I)
  138 YN2(I) = Y(I)
      RETURN
  140 XN1 = X
      DO 142  I=1,N
      YPN1(I)  =  YYP(I)
      YN1(I) = Y(I)
  142 CONTINUE
      RETURN
  145 XN = X
      DO 146  I=1,N
      YN(I) = Y(I)
      YPN (I)  =  YYP(I)
  146 CONTINUE
      NSTEP = 0
      NFIRST = 1
      NCRE = 0
      NDO = NGO + 1
      RETURN
C
C
C      FIXED ADAMS MOULTON PREDICTOR METHOD
C
  200 XOO = X
      H = HH
      X = XOO  +  HH
      DO 220  I=1,N
      Y(I) = YN(I)+H*(55.DO*YPN(I)-59.DO*YPN1(I)+37.DO*YPN2(I)-9.0DO*
     4   YPN3(I)) / 24.DO
        YY(I)  = Y(I)
  220 CONTINUE
      CALL  DAUX
      DO 225  I=1,N
      DY = YYP(I)
      Y(I) = YN(I)+H*(9.DO*DY   +19.DO*YPN(I)-5.DO*YPN1(I)+YPN2(I))
     5    / 24.DO
        YY(I)  = Y(I)
  225 CONTINUE
      CALL  DAUX
      DO 250  I=1,N
C     SAVE VALUES
      YPN3(I) = YPN2(I)
      YPN2(I) = YPN1(I)
      YPN1(I) = YPN(I)
```

```
      YPN(I)   =   YYP(I)
      YN3(I) = YN2(I)
      YN2(I) = YN1(I)
      YN1(I) = YN(I)
      YN(I) = Y(I)
  250 CONTINUE
  251 XN3 = XN2
      XN2 = XN1
      XN1 = XN
      XN = X
      RETURN
C
C     VARIABLE ADAMS MOULTON METHOD
C
C
  300 XOO = X
      H = HH
      X = XOO  +  HH
      DO 364  I=1,N
       Y(I)= YN(I)+H*(55.D0*YPN(I)-59.D0*YPN1(I)+37.D0*YPN2(I)-9.D0*
     6        YPN3(I)) / 24.D0
        YY(I)  = Y(I)
      P(I) = Y(I)
  364 CONTINUE
      CALL  DAUX
      DO 365  I=1,N
      DY = YYP(I)
      Y(I) = YN(I)+H*(9.D0*DY   +19.D0*YPN(I)-5.D0*YPN1(I)+YPN2(I))
     7          / 24.D0
        YY(I)  = Y(I)
  365 CONTINUE
      CALL  DAUX
C
C     END VARIABLE ADAM MOULTON
C
      ERROR = 0.0
      DO 370  I=1,N
      PRED = SNGL(P(I))
C
C     SAVE VALUES
  366 YPNO(I) = YPN3(I)
      YPN3(I) = YPN2(I)
      YPN2(I) = YPN1(I)
      YPN1(I) = YPN(I)
      YPN(I)  = YYP(I)
      YNO(I) = YN3(I)
      YN3(I) = YN2(I)
      YN2(I) = YN1(I)
      YN1(I) = YN(I)
      YN(I) = Y(I)
      DD = AMAX1(ABS(SNGL(Y(I))),AA)
      DERR = ABS(PRED-SNGL(Y(I)))/(14.0*DD)
      ERROR = AMAX1(ERROR,DERR)
  370 CONTINUE
  375 XNO = XN3
```

```
      XN3 = XN2
      XN2 = XN1
      XN1 = XN
      XN = X
C     ERROR TESTS     ADAMS MOULTON
C
  305 IF (ERROR.GT.EMAX) GO TO 315
      NFIRST = 2
      IF (ERROR.LT.EMIN) GO TO 330
  306 NFIRST = 2
      NCRE = 0
      RETURN
C
C     REDUCE STEP SIZE
C
  315 NSS=2
      NCRE = 0
  316 HH = HH*BETA
      IF( ABS(HH) .GT.  HMIN  )  GO  TO  319
      HH = SIGN( HMIN, HH  )
      IF (NMSG.NE.0) GO TO 306
C
C     CALL ERRMSG(10  ,39H  MINIMUM STEP SIZE  IN  PINT1
      WRITE(6,317)
  317 FORMAT(28H0 MINIMUM STEP SIZE IN PINT1)
C
      NMSG = 1
      A(1) =-A(1)
C
  319 GO TO (    320,325), NFIRST
C     ERROR FIRST VARIABLE POINT
  320 X = XN0
      DO 321  I=1,N
      YY(I) = YN0(I)
  321 CONTINUE
      GO TO   100
C     ERROR DURING VARIABLE MODE
  325 X = XN1
      DO 327  I=1,N
      YY(I) = YN1(I)
  327 CONTINUE
      GO TO   100
C
C     INCREASE STEP SIZE HERE
C
  330 NSS = 1
      NCRE = NCRE + 1
      IF (NCRE.LE.2) RETURN
C     NOW INCREASE
  335 NCRE = 0
      HH = SIGN(AMIN1(ABS(HH/BETA),HMAX),HH)
      GO TO 106
      END
```

```
      SUBROUTINE PLOTTP(IPLT)                                           PLOT0010
      COMMON/INPT/PHIO,THETAO,PSIO,PO,QO,RO,XCOP,YCOP,ZCOP,UO,VO,WO,    PLOT0020
     1          A,B,DEL10,DEL20,DEL30,PHIRO,DEL10D,DEL20D,DEL30D,       PLOT0030
     2          PHIROD,TF,TR,ZF,ZR,RHO,AKRS,XMUR,                        PLOT0040
     3          XMS,XMUF,XIX,XIY,XIZ,XIXZ,CF,AKF,XLAMF,OMEGF,CFP,EPSF,PLOT0050
     4          RF,CR,AKR,XLAMR,OMEGR,CRP,EPSR,RR,TS,THMAX,DTCOMP,TO,  PLOT0060
     5          T1,DTCMP1,DTPRNT,MODE,EBAR,EM,AAA,HMAX,HMIN,BET,G,      PLOT0070
     6          HED(36),DADE(3),XIR,X1,Y1,Z1,X2,Y2,Z2,PHIC(50),DELB,    PLOT0080
     7          DELE,DDEL,NDEL,PSIF(50),TQF(50),TQR(50),TB,TE,TINCR,   PLOT0090
     8          NZTAB,NZ5,XBDRY(4,5),PSBDRY(4,5),YBDRY(2,5),NBX(5),    PLOT0100
     9          NBY(5),NTBL1,NTBL2,NTBL3,ZGP(21,21,5)                   PLOT0110
      COMMON/INPT/XB(5),XE(5),XINCR(5),NX(5),YB(5),YE(5),YINCR(5),NY(5),PLOT0120
     1        XXZGP5(21),YYZGP5(21),AMUG(5),PSBDRO(4,5),UVWMIN,PQRMIN  PLOT0130
      COMMON /INTG/NEQ,T,DT,VAR(50),DER(50)                             PLOT0140
      EQUIVALENCE (U,VAR(1)),(V,VAR(2)),(W,VAR(3)),(P,VAR(4)),(Q,VAR(5))PLOT0150
     1          ,(R,VAR(6)),(DEL1,VAR(7)),(DEL1D,VAR(8)),(DEL2,VAR(9)),PLOT0160
     2          (DEL2D,VAR(10)),(DEL3,VAR(11)),(DEL3D,VAR(12)),         PLOT0170
     3          (PHIR,VAR(13)),(PHIRD,VAR(14)),(THETTP,VAR(15)),        PLOT0180
     4          (PHITP,VAR(16)),(PSITP,VAR(17)),(XCP,VAR(18)),          PLOT0190
     5          (YCP,VAR(19)),(ZCP,VAR(20)),(PSIFI,VAR(21)),            PLOT0200
     6          (PSIFID,VAR(22))                                        PLOT0210
      EQUIVALENCE (DU,DER(1)),(DV,DER(2)),(DW,DER(3)),(DP,DER(4)),      PLOT0220
     1          (DQ,DER(5)),(DR,DER(6)),(DDEL1,DER(7)),(DDEL1D,DER(8))PLOT0230
     2          ,(DDEL2,DER(9)),(DDEL2D,DER(10)),(DDEL3,DER(11)),       PLOT0240
     3          (DDEL3D,DER(12)),(DPHIR,DER(13)),(DPHIRD,DER(14)),      PLOT0250
     4          (DTHTTP,DER(15)),(DPHITP,DER(16)),(DPSITP,DER(17)),     PLOT0260
     5          (DXCP,DER(18)),(DYCP,DER(19)),(DZCP,DER(20)),           PLOT0270
     6          (DPSIFI,DER(21)),(DDPSFI,DER(22))                       PLOT0280
      EQUIVALENCE (VAR(9),PHIF),(VAR(10),PHIFD),(DER(9),DPHIF),         PLOT0290
     1          (DER(10),DPHIFD)                                        PLOT0300
      EQUIVALENCE (VAR(13),DEL4),(VAR(14),DEL4D),(DER(13),DDEL4),       PLOT0310
     1          (DER(14),DDEL4D)                                        PLOT0320
      COMMON /DIMV/X1P,X2P,X3P,X4P,Y1P,Y2P,Y3P,Y4P,Z1P,Z2P,Z3P,Z4P,PHI1,PLOT0330
     1          PHI2,PHI3,PHI4,PSI1,PSI2,PSI3,PSI4,CAYW(4),CBYW(4),     PLOT0340
     2          CGYW(4),ZPGI(4),THGI(4),PHGI(4),CPG(4),SPG(4),CTG(4),PLOT0350
     3          STG(4),CAGZ(4),CBGZ(4),CGGZ(4),D1(4),D2(4),D3(4),       PLOT0360
     4          XLM1(4),XLM2(4),XLM3(4),AMTX(3,3),CMTX(3,4),XGPP(4),   PLOT0370
     5          YGPP(4),ZGPP(4),DMATX(10,11),DELTA(4),CAR(4),CBR(4),   PLOT0380
     6          CGR(4),FR(4),HI(4),FC(4),TI(4),AX(4),BX(4),CX(4),       PLOT0390
     7          CTXG(4),UG(4),STXG(4),AY(4),BY(4),CY(4),CPYG(4),        PLOT0400
     8          SPYG(4),VG(4),PSIIP(4),PHICI(4),CAC(4),CBC(4),CGC(4),PLOT0410
     9          FCXU(4),FCYU(4),FCZU(4),FS(4),CAXW(4),CBXW(4),CGXW(4)PLOT0420
      COMMON /DIMV/AS(4),BS(4),CS(4),CAS(4),CBS(4),CGS(4),BETP(4),      PLOT0430
     1          BETBR(4),FSXU(4),FSYU(4),FSZU(4),FRXU(4),FRYU(4),       PLOT0440
     2          FRZU(4),FXU(4),FYU(4),FZU(4),SI(4),F1FI(2),F1RI(2),     PLOT0450
     3          F2FI(2),F2RI(2),CAH(4),CBH(4),CGH(4)                    PLOT0460
      DIMENSION XP(4),YP(4),ZP(4),PHII(4),PSII(4)                       PLOT0470
      EQUIVALENCE (XP(1),X1P),(YP(1),Y1P),(ZP(1),Z1P),(PHII(1),PHI1),   PLOT0480
     1          (PSII(1),PSI1)                                          PLOT0490
```

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      COMMON /COMP/SUMM,THETN,PHIN,PSIN,PI,RAD,GAM1,GAM2,GAM3,GAM4,GAM5,PLOT0500
     1            GAM6,GAM7,GAM8,GAM9,THETT,PHIT,PSIT,ZRO,TRO2,           PLOT0510
     2             TFO2,TIZ,RHO2,RHOMUR,AMUF,BMUR,ZPR,TM4,RHMR2,AO2APB,  PLOT0520
     3             BO2APB,RFTF,TSO2,RRTS,BROMUR,XMUFO2,AXMFO2,XMTFO4,    PLOT0530
     4             XIZR,RTR,RHMR2I,XIXP,XIZP,XIXZP,XIYZP,D1PD2,D1MD2,    PLOT0540
     5             ZRD3,ZRD3R,ZFD3R,ZFD12,TIZ2,TG61,DD1P2,DD1M2,RPR,PHRPPLOT0550
     6            ,TANTP,SPHTP,CPHTP,SECTP,SFXS,SFYS,SFZS,SNPS,SNTS,      PLOT0560
     7             SNPSS,TPR,CAY,CBY,CGY,CAX,CBX,CGX,SFYU,SFXU,SFYUF,     PLOT0570
     8             SFYUR,SFZU,COSTH,SINTH,COSPS,SINPS,COSPH,SINPH,ANG1,  PLOT0580
     9             ANG2,CPHI,SPHI,CPSI,SPSI,P1,P7,P3,P4,P5,P6,TX,TY,TZ    PLOT0590
      COMMON /COMP/TRH,DISTX,DISTY,DISTD,DISTS,D21,ZETA4,ZETA4D,ZETA3,   PLOT0600
     1             ZETA3D,SFZ1,SNPU,SNTU,HCGH1,HCGH2,HCGH3,HCGH4,TERM1,  PLOT0610
     2             TERM2,SNPSU,SNPR,HCBH1,HCBH2,HCBH3,HCBH4,HCAH1,HCAH2,PLOT0620
     3             HCAH3,HCAH4,UQ,WP,UR,QR,VP,PR,P2,Q2,R2,VR,WQ,PQ,PHIR2PLOT0630
     4            ,PHIRD2,RPHRD,GCTH,GSTH,GCTSP,GCTCP,XXX,YYY,IX,IY,XX1,PLOT0640
     5             XX2,YY1,YY2,THG1,THG2,PHG1,PHG2,ZZ1,ZZ2,LLL            PLOT0650
      DIMENSION HCAH(4),HCBH(4),HCGH(4)                                  PLOT0660
      EQUIVALENCE (HCAH(1),HCAH1),(HCBH(1),HCBH1),(HCGH(1),HCGH1)        PLOT0670
      COMMON /COMPN/ FRSP(4),FRCP(4),ICBHIT,JCBHIT,                      PLOT0680
     1               DPSINT,TANPC1,TANPC2,PHIC1R,PHIC2R,AMUCMP,PHI1D,    PLOT0690
     2               PHI2D,LCB1(4),LCB2(4),IHIT,AJMTX(3,3),BMTX(3,3),    PLOT0700
     3               SFRX(4),SFRY(4),SFRZ(4),T1PSI,T2PSI,XMUGI(4)        PLOT0710
      LOGICAL LCB1,LCB2                                                  PLOT0720
      COMMON /TIRIN/ AKT(4),SIGT(4),XLAMT(4),AO(4),A1(4),A2(4),A3(4),    PLOT0730
     1               A4(4),OMEGT(4),AMU(4),RW(4),FJP(35,4),A234(4),      PLOT0740
     2               A12(4),OMT2A2(4),OMT2M1(4),A23(4),ITIR(4)           PLOT0750
      DIMENSION ICONTW(4)                                                PLOT0760
      DATA TTTTTT/-9999.0/                                               PLOT0770
    1 GO TO (2,3,4),IPLT                                                 PLOT0780
    2 WRITE(1)HED,DADE,A,B,TS,ZR,RHO,ZF,RW(1),TF,TR                      PLOT0790
      RETURN                                                             PLOT0800
    3 DO 6 J=1,4                                                         PLOT0810
      IF(FRCP(J).GT.0.01) GO TO 5                                        PLOT0820
      ICONTW(J) = 0                                                      PLOT0830
      GO TO 6                                                            PLOT0840
5     ICONTW(J) = 1                                                      PLOT0850
      IF(ABS(BETBR(J)).GT.3.0) ICONTW(J)= -1                             PLOT0860
6     CONTINUE                                                           PLOT0870
      WRITE(1) T,XCP,YCP,ZCP,PHIT,THETT,PSIT,DEL1,DEL2,DEL3,PHIR,PSI1,   PLOT0880
     1 PHI1,PHI2,(XGPP(J),YGPP(J),ZGPP(J),J=1,4),ICONTW                  PLOT0890
      RETURN                                                             PLOT0900
    4 WRITE(1) (TTTTTT,I=1,30)                                           PLOT0910
      RETURN                                                             PLOT0920
      END                                                                PLOT0930
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      SUBROUTINE RUFFRC(I,ZGM)
C          HVOSM-RD2 VERSION
C          HVOSM-VD2 VERSION
C              REVISED OCTOBER 1975  CALSPAN CORPORATION
      COMMON/INPT1/YC1P,YC2P,ZC2P,DELTC,PHIC1,PHIC2,AMUC,XIPS,
     1             CPSP,OMGPS,AKPS,EPSPS,XPS,RWHJB,RWHJE,DRWHJ,INDCRE,
     2             PSIFIO,PSIFDO
      DIMENSION YC1P(2)
      EQUIVALENCE (YC1P(1),YC1P)
      COMMON /DIMV/X1P,X2P,X3P,X4P,Y1P,Y2P,Y3P,Y4P,Z1P,Z2P,Z3P,Z4P,PHI1,
     1             PHI2,PHI3,PHI4,PSI1,PSI2,PSI3,PSI4,CAYW(4),CBYW(4),
     2             CGYW(4),ZPGI(4),THGI(4),PHGI(4),CPG(4),SPG(4),CTG(4),
     3             STG(4),CAGZ(4),CBGZ(4),CGGZ(4),D1(4),D2(4),D3(4),
     4             XLM1(4),XLM2(4),XLM3(4),AMTX(3,3),CMTX(3,4),XGPP(4),
     5             YGPP(4),ZGPP(4),DMATX(10,11),DELTA(4),CAR(4),CBR(4),
     6             CGR(4),FR(4),HI(4),FC(4),TI(4),AX(4),BX(4),CX(4),
     7             CTXG(4),UG(4),STXG(4),AY(4),BY(4),CY(4),CPYG(4),
     8             SPYG(4),VG(4),PSIIP(4),PHICI(4),CAC(4),CBC(4),CGC(4),
     9             FCXU(4),FCYU(4),FCZU(4),FS(4),CAXW(4),CBXW(4),CGXW(4)
      COMMON /DIMV/AS(4),BS(4),CS(4),CAS(4),CBS(4),CGS(4),BETP(4),
     1             BETBR(4),FSXU(4),FSYU(4),FSZU(4),FRXU(4),FRYU(4),
     2             FRZU(4),FXU(4),FYU(4),FZU(4),SI(4),F1FI(2),F1RI(2),
     3             F2FI(2),F2RI(2),CAH(4),CBH(4),CGH(4)
      DIMENSION XP(4),YP(4),ZP(4),PHII(4),PSII(4)
      EQUIVALENCE (XP(1),X1P),(YP(1),Y1P),(ZP(1),Z1P),(PHII(1),PHI1),
     1            (PSII(1),PSI1)
      COMMON /COMP/SUMM,THETN,PHIN,PSIN,PI,RAD,GAM1,GAM2,GAM3,GAM4,GAM5,
     1            GAM6,GAM7,GAM8,GAM9,THETT,PHIT,PSIT,ZRO,TRO2,
     2             TFO2,TIZ,RHO2,RHOMUR,AMUF,BMUR,ZPR,TM4,RHMR2,AO2APB,
     3             BO2APB,RFTF,TSO2,RRTS,BROMUR,XMUFO2,AXMFO2,XMTFO4,
     4             XIZR,RTR,RHMR2I,XIXP,XIZP,XIX2P,XIYZP,D1PD2,D1MD2,
     5             ZRD3,ZRD3R,ZFD3R,ZFD12,TIZ2,TG61,DD1P2,DD1M2,RPR,PHRP
     6            ,TANTP,SPHTP,CPHTP,SECTP,SFXS,SFYS,SFZS,SNPS,SNTS,
     7             SNPSS,TPR,CAY,CBY,CGY,CAX,CBX,CGX,SFYU,SFXU,SFYUF,
     8             SFYUR,SFZU,COSTH,SINTH,COSPS,SINPS,COSPH,SINPH,ANG1,
     9             ANG2,CPHI,SPHI,CPSI,SPSI,P1,P7,P3,P4,P5,P6,TX,TY,TZ
      COMMON /COMP/TRH,DISTX,DISTY,DISTD,DISTS,D21,ZETA4,ZETA4D,ZETA3,
     1             ZETA3D,SFZ1,SNPU,SNTU,HCGH1,HCGH2,HCGH3,HCGH4,TERM1,
     2             TERM2,SNPSU,SNPR,HCBH1,HCBH2,HCBH3,HCBH4,HCAH1,HCAH2,
     3             HCAH3,HCAH4,UQ,WP,UR,QR,VP,PR,P2,Q2,R2,VR,WQ,PQ,PHIR2
     4            ,PHIRD2,RPHRD,GCTH,GSTH,GCTSP,GCTCP,XXX,YYY,IX,IY,XX1,
     5             XX2,YY1,YY2,THG1,THG2,PHG1,PHG2,ZZ1,ZZ2,LLL
      DIMENSION HCAH(4),HCBH(4),HCGH(4)
      EQUIVALENCE (HCAH(1),HCAH1),(HCBH(1),HCBH1),(HCGH(1),HCGH1)
      COMMON /COMPN/ FRSP(4),FRCP(4),ICBHIT,JCBHIT,
     1                DPSINT,TANPC1,TANPC2,PHIC1R,PHIC2R,AMUCMP,PHI1D,
     2                PHI2D,LCB1(4),LCB2(4),IHIT,AJMTX(3,3),BMTX(3,3),
     3                SFRX(4),SFRY(4),SFRZ(4),T1PSI,T2PSI,XMUGI(4)
      LOGICAL LCB1,LCB2
```

```
      COMMON /TIRIN/ AKT(4),SIGT(4),XLAMT(4),A0(4),A1(4),A2(4),A3(4),   RUFF0500
     1               A4(4),OMEGT(4),AMU(4),RW(4),FJP(35,4),A234(4),     RUFF0510
     2               A12(4),OMT2A2(4),OMT2M1(4),A23(4),ITIR(4)          RUFF0520
      COMMON /RUFNES/ DELG,DGMAX,NEND,IRUF                              RUFF0530
      DIMENSION ZGM(2205)                                               RUFF0540
      DIMENSION FJPP(35)                                                RUFF0550
      DO 20 N=1,35                                                      RUFF0560
   20 FJPP(N) = FJP(N,I)                                                RUFF0570
      SNPSI = SIN(PSII(I))                                              RUFF0580
      CSPSI = COS(PSII(I))                                              RUFF0590
      SNPHI = SIN(PHII(I))                                              RUFF0600
      CSPHI = COS(PHII(I))                                              RUFF0610
      SFRX(I) = 0.0                                                     RUFF0620
      SFRY(I) = 0.0                                                     RUFF0630
      SFRZ(I) = 0.0                                                     RUFF0640
      TTAJ21 = CSPHI*SNPSI                                              RUFF0650
      TTAJ31 = SNPHI*SNPSI                                              RUFF0660
      AJMTX(1,2) = -SNPSI                                               RUFF0670
      AJMTX(2,2) = CSPHI*CSPSI                                          RUFF0680
      AJMTX(3,2) = SNPHI*CSPSI                                          RUFF0690
      INDF = 0                                                          RUFF0700
      INDL = 0                                                          RUFF0710
      MF = IFIX((XP(I)-RW(I))/DELG)                                     RUFF0720
      ML = MF+IFIX(2.0*RW(I)/DELG)                                      RUFF0730
      IF(MF.GE.1) GO TO 10                                              RUFF0740
      MF = 1                                                            RUFF0750
      INDF = 1                                                          RUFF0760
   10 IF(ML.LE.NEND) GO TO 11                                           RUFF0770
      ML = NEND                                                         RUFF0780
      INDL = 1                                                          RUFF0790
   11 DO 100 J=1,21                                                     RUFF0800
      THTJ = (-44.0+4.0*J)*RAD                                          RUFF0810
      STJ = SIN(THTJ)                                                   RUFF0820
      CTJ = COS(THTJ)                                                   RUFF0830
      AJMTX(1,1) = CTJ*CSPSI                                            RUFF0840
      AJMTX(2,1) = TTAJ21*CTJ+SNPHI*STJ                                 RUFF0850
      AJMTX(3,1) = TTAJ31*CTJ-CSPHI*STJ                                 RUFF0860
      AJMTX(1,3) = CSPHI*STJ                                            RUFF0870
      AJMTX(2,3) = TTAJ21*STJ-SNPHI*CTJ                                 RUFF0880
      AJMTX(3,3) = TTAJ31*STJ+CSPHI*CTJ                                 RUFF0890
      DO 8 K=1,3                                                        RUFF0900
      DO 7 L=1,3                                                        RUFF0910
      BMTX(K,L) = 0.0                                                   RUFF0920
      DO 6 M=1,3                                                        RUFF0930
    6 BMTX(K,L) = BMTX(K,L)+AMTX(K,M)*AJMTX(M,L)                        RUFF0940
    7 CONTINUE                                                          RUFF0950
    8 CONTINUE                                                          RUFF0960
      IF(BMTX(3,3).EQ.0.0) GO TO 100                                    RUFF0970
      DO 50 M=MF,ML                                                     RUFF0980
      ZM1 = 0.0                                                         RUFF0990
      IF(M.LT.NEND) ZM1 = ZGM(M+1)                                      RUFF1000
```

```
      XM = DELG*(M-1)                                                   RUFF1010
      XM1 = XM+DELG                                                     RUFF1020
      TMP = (BMTX(1,3)*(ZM1-ZGM(M))/(BMTX(3,3)*DELG))                   RUFF1030
      IF(TMP.EQ.1) GO TO 50                                             RUFF1040
      XD = XM-XP(I)                                                     RUFF1050
      XD1 = XM1-XP(I)                                                   RUFF1060
      IF(ABS(XD).LT.0.001.OR.ABS(XD1).LT.0.001) GO TO 49                RUFF1070
      SM = (ZGM(M)-ZP(I))/XD                                            RUFF1080
      SM1 = (ZM1-ZP(I))/XD1                                             RUFF1090
      SGM = SIGN(1.0,SM)                                                RUFF1100
      SGM1 = SIGN(1.0,SM1)                                              RUFF1110
      IF(SGM.GT.0.0.AND.SGM1.LT.0.0) GO TO 50                           RUFF1120
      IF(SGM.EQ.SGM1.AND.SM1.GT.SM) GO TO 50                            RUFF1130
   49 TMP1 = 1.0/(1.0-TMP)                                              RUFF1140
      XJP = TMP1*(XP(I)+BMTX(1,3)*(ZGM(M)-ZP(I)-XM*                     RUFF1150
     1     (ZM1-ZGM(M))/DELG)/BMTX(3,3))                                RUFF1160
      IF(XJP.GE.XM) GO TO 60                                            RUFF1170
      IF(XJP.GE.0.0) GO TO 100                                          RUFF1180
      GO TO 69                                                          RUFF1190
   60 IF(XJP.LE.XM1) GO TO 70                                           RUFF1200
   50 CONTINUE                                                          RUFF1210
      GO TO 69                                                          RUFF1220
   70 IF(ABS(BMTX(1,3)).LT.0.0001) GO TO 71                             RUFF1230
      HJ = (XJP-XP(I))/BMTX(1,3)                                        RUFF1240
      ZJP = ZP(I)+BMTX(3,3)*HJ                                          RUFF1250
      GO TO 72                                                          RUFF1260
   71 ZJP = ZGM(M)+(XJP-XM)*(ZM1-ZGM(M))/DELG                           RUFF1270
      HJ = (ZJP-ZP(I))/BMTX(3,3)                                        RUFF1280
      XJP = XP(I)                                                       RUFF1290
      GO TO 72                                                          RUFF1300
   69 ZJP = 0.0                                                         RUFF1310
      XJP = XP(I)-BMTX(1,3)*ZP(I)/BMTX(3,3)                             RUFF1320
      HJ = -ZP(I)/BMTX(3,3)                                             RUFF1330
   72 YJP = YP(I)+BMTX(2,3)*HJ                                          RUFF1340
      IF(HJ.LT.0.0.OR.HJ.GT.RW(I)) GO TO 100                            RUFF1350
      CAJ = (XP(I)-XJP)/HJ                                              RUFF1360
      CBJ = (YP(I)-YJP)/HJ                                              RUFF1370
      CGJ = (ZP(I)-ZJP)/HJ                                              RUFF1380
      CALL INTRPL(FJPP,RWHJB,RWHJE,DRWHJ,RW(I)-HJ,FJ)                   RUFF1390
      SFRX(I) = SFRX(I)+FJ*CAJ                                          RUFF1400
      SFRY(I) = SFRY(I)+FJ*CBJ                                          RUFF1410
      SFRZ(I) = SFRZ(I)+FJ*CGJ                                          RUFF1420
  100 CONTINUE                                                          RUFF1430
      FR(I) = SQRT(SFRX(I)**2+SFRY(I)**2+SFRZ(I)**2)                    RUFF1440
      IF(FR(I).NE.0.0) GO TO 110                                        RUFF1450
      CAR(I) = 0.0                                                      RUFF1460
      CBR(I) = 0.0                                                      RUFF1470
      CGR(I) = 1.0                                                          1480
      HI(I) = RW(I)                                                         1490
      PHGI(I) = 0.0                                                         1500
      THGI(I) = 0.0                                                         1510
```

```
      SPG(I) = 0.0
      TXGP = XP(I)
      GO TO 112
  110 CAR(I) = -SFRX(I)/FR(I)
      CBR(I) = -SFRY(I)/FR(I)
      CGR(I) = -SFRZ(I)/FR(I)
      HI(I) = RW(I)-FR(I)/AKT(I)
      IF(HI(I).GT.RW(I)-SIGT(I)) GO TO 111
      HI(I) = RW(I)-(FR(I)/AKT(I)+SIGT(I)*(XLAMT(I)-1.0))/XLAMT(I)
  111 TXGP = XP(I)+HI(I)*CAR(I)
      ME = TXGP/DELG+1
      TPHGI = 0.0
      TTHGI = ATAN2((ZGM(ME)-ZGM(ME+1)),DELG)
      TAI = CBR(I)*CGYW(I)-CGR(I)*CBYW(I)
      TBI = CGR(I)*CAYW(I)-CAR(I)*CGYW(I)
      TCI = CAR(I)*CBYW(I)-CBR(I)*CAYW(I)
      STI = SIN(TTHGI)
      CTI = COS(TTHGI)
      DN1 = (TCI*TCI+TBI*TBI)*STI-TAI*TCI*CTI
      DN2 = -TBI*(TAI*STI+TCI*CTI)
      DN3 = (TAI*TAI+TBI*TBI)*CTI-TAI*TCI*STI
      TERM5 = SQRT(DN1*DN1+DN2*DN2+DN3*DN3)
      SPG(I) = -DN2/TERM5
      PHGI(I) = ARSIN(SPG(I))
      THGI(I) = ATAN(DN1/DN3)
  112 CPG(I) = COS(PHGI(I))
      CTG(I) = COS(THGI(I))
      STG(I) = SIN(THGI(I))
      XGPP(I) = TXGP
      YGPP(I) = YP(I)+HI(I)*CBR(I)
      ZGPP(I) = ZP(I)+HI(I)*CGR(I)
      RETURN
      END
```

```
      SUBROUTINE RUFRED(NEND,DELG,DGMAX,ZRTAB)
C             HVOSM-VD2 VERSION
C             REVISED OCTOBER 1975   CALSPAN CORPORATION
C             HVOSM-RD2 VERSION
C          HVOSM-VD2 VERSION
C             REVISED OCTOBER 1975  CALSPAN CORPORATION
      DIMENSION ZRTAB(2205)
      IF(NEND.GT.2200) GO TO 900
      READ(4,END=901) (ZRTAB(I),I=1,NEND)
      GO TO 12
  901 WRITE(6,9001)
 9001 FORMAT('      END OF FILE ENCOUNTERED IN READ OF ROUGHNESS '/
     1    '  DATA BEFORE NEND POINTS WERE READ.'  )
      NEND = I
   12 DGMAX = (NEND-1)*DELG
      RETURN
  900 WRITE(6,9000)
 9000 FORMAT('      NUMBER OF LAST ROUGHNESS DATA POINT IS GREATER '/
     1    ' THAN THE ALLOWED 2200.  PROGRAM TERMINATED.'  )
      STOP
      END
```

```
      SUBROUTINE SIMSOL (A,KK,LL)
C***********************************************************************
C*                                                                     *
C*    SUBROUTINE SIMSOL      (SINGLE PRECISION VERSION)                *
C*                                                                     *
C*    AUTHOR                                                           *
C*       DR.JOHN T. FLECK                                              *
C*       (REVISED BY F.E. BUTLER)                                      *
C*                                                                     *
C*    REFERENCE                                                        *
C*       ''SUBROUTINES TO SOLVE AN INDEPENDENT SET OF LINEAR           *
C*       SIMULTANEOUS EQUATIONS''  HS/FEB/PAW-84, 21 JULY 1965.        *
C*                                                                     *
C*    PURPOSE                                                          *
C*       TO SOLVE A SET OF SIMULTANEOUS LINEAR EQUATIONS, AX=B.        *
C*                                                                     *
C*    USAGE                                                            *
C*       CALL SIMSOL (A,N,ND1)                                         *
C*                                                                     *
C*    DESCRIPTION OF PARAMETERS                                        *
C*       A - IS A 2-DIMENSIONAL (ND1*ND2) MATRIX OF COEFFICIENTS.      *
C*       N - IS THE NUMBER OF EQUATIONS AND UNKNOWNS.                  *
C*       ND1 - IS THE FIRST DIMENSION OF A IN CALLING PROGRAM.         *
C*            ( ND1.GE.N  AND  ND2.GE.N+1 )                            *
C*                                                                     *
C*    CALLING PROGRAM SETUP                                            *
C*       A(I,J) FOR I,J=1,N                                            *
C*       A(I,N+1)=B(I) FOR I=1,N                                       *
C*       THE SOLUTION IS RETURNED IN COLUMN N+1 OF MATRIX A.           *
C*       MATRIX A IS DESTROYED BY THE SUBROUTINE.                      *
 1000 CONTINUE
C*    REMARKS                                                          *
C*       IF MATRIX A IS SINGULAR, AN ERROR MESSAGE IS PRINTED          *
C*       AND THE JOB IS TERMINATED.                                    *
C*                                                                     *
C*    METHOD                                                           *
C*       SOLUTION IS OBTAINED BY ELIMINATION USING LARGEST PIVOTAL     *
C*       DIVISOR OF EACH COLUMN. EACH STAGE OF ELIMINATION CONSISTS    *
C*       OF INTERCHANGING ROWS WHEN NECESSARY TO AVOID DIVISION BY     *
C*       ZERO OR SMALL NUMBERS.                                        *
C*       THE FORWARD SOLUTION TO OBTAIN VARIABLE N IS DONE IN N        *
C*       STAGES. THE BACK SOLUTION FOR THE OTHER VARIABLES IS          *
C*       CALCULATED BY SUCCESSIVE SUBSTITUTIONS. FINAL SOLUTION        *
C*       VALUES ARE DEVELOPED IN COLUMN N+1 OF MATRIX A, WITH          *
C*       VARIABLE 1 IN A(1,N+1), VARIABLE 2 IN A(2,N+1),.....,         *
C*       VARIABLE N IN A(N,N+1).                                       *
C*                                                                     *
C***********************************************************************
      REAL A(LL,1),B,BIG
      N  = KK
      N1 = N+1
      DO 50  L=1,N
      L1 = L+1
      BIG = 0.0
      DO 25  I=L,N
      IF (ABS(A(I,L)).LE.ABS(BIG)) GO TO 25
      K = I
      BIG = A(I,L)
```

```
   25 CONTINUE
      IF (BIG.NE.0.0) GO TO 30
      WRITE(6,32000)
32000  FORMAT(24H SIMSOL MATRIX SINGULAR.)
      STOP
   30 DO 40  J=L,N1
      IF (K.EQ.L) GO TO 40
      B       = A(K,J)
      A(K,J) = A(L,J)
      A(L,J) = B
   40 A(L,J) = A(L,J)/BIG
      IF (L.EQ.N) GO TO 50
      DO 48  I=L1,N
      IF (A(I,L).EQ.0.0) GO TO 48
      DO 45  J=L1,N1
   45 A(I,J) = A(I,J)-A(I,L)*A(L,J)
   48 CONTINUE
   50 CONTINUE
      IF (N.EQ.1) RETURN
      N2 = N-1
      DO 60  L=1,N2
      I  = N-L
      L1 = I+1
      DO 60  J=L1,N
   60 A(I,N1) = A(I,N1)-A(I,J)*A(J,N1)
      RETURN
      END
```

```
      SUBROUTINE SUSFRC(DISP,VEL)                                       SUSF0010
C             HVOSM-VD2 VERSION                                         SUSF0020
C             REVISED OCTOBER 1975   CALSPAN CORPORATION                SUSF0030
C                                                                       SUSF0040
C  SUBROUTINE TO COMPUTE SUSPENSION FORCES ACTING BETWEEN SPRUNG        SUSF0050
C  AND UNSPRUNG MASSES                                                  SUSF0060
C                                                                       SUSF0070
      COMMON/INPT/PHIO,THETAO,PSIO,PO,QO,RO,XCOP,YCOP,ZCOP,UO,VO,WO,    SUSF0080
     1           A,B,DEL10,DEL20,DEL30,PHIRO,DEL10D,DEL20D,DEL30D,      SUSF0090
     2           PHIROD,TF,TR,ZF,ZR,RHO,AKRS,XMUR,                      SUSF0100
     3           XMS,XMUF,XIX,XIY,XIZ,XIXZ,CF,AKF,XLAMF,OMEGF,CFP,EPSF,SUSF0110
     4           RF,CR,AKR,XLAMR,OMEGR,CRP,EPSR,RR,TS,THMAX,DTCOMP,TO,  SUSF0120
     5           T1,DTCMP1,DTPRNT,MODE,EBAR,EM,AAA,HMAX,HMIN,BET,G,     SUSF0130
     6           HED(36),DADE(3),XIR,X1,Y1,Z1,X2,Y2,Z2,PHIC(50),DELB,   SUSF0140
     7           DELE,DDEL,NDEL,PSIF(50),TQF(50),TQR(50),TB,TE,TINCR,   SUSF0150
     8           NZTAB,NZ5,XBDRY(4,5),PSBDRY(4,5),YBDRY(2,5),NBX(5),    SUSF0160
     9           NBY(5),NTBL1,NTBL2,NTBL3,ZGP(21,21,5)                  SUSF0170
      COMMON/INPT/XB(5),XE(5),XINCR(5),NX(5),YB(5),YE(5),YINCR(5),NY(5),SUSF0180
     1         XXZGP5(21),YYZGP5(21),AMUG(5),PSBDRO(4,5),UVWMIN,PQRMIN  SUSF0190
      COMMON/INPT3/ AKFC,AKFCP,OMEGFC,AKFE,AKFEP,OMEGFE,AKRC,AKRCP,     SUSF0200
     1              OMEGRC,AKRE,AKREP,OMEGRE,END3                       SUSF0210
      COMMON /INTG/NEQ,T,DT,VAR(50),DER(50)                             SUSF0220
      EQUIVALENCE (U,VAR(1)),(V,VAR(2)),(W,VAR(3)),(P,VAR(4)),(Q,VAR(5))SUSF0230
     1          ,(R,VAR(6)),(DEL1,VAR(7)),(DEL1D,VAR(8)),(DEL2,VAR(9)),SUSF0240
     2           (DEL2D,VAR(10)),(DEL3,VAR(11)),(DEL3D,VAR(12)),        SUSF0250
     3           (PHIR,VAR(13)),(PHIRD,VAR(14)),(THETTP,VAR(15)),       SUSF0260
     4           (PHITP,VAR(16)),(PSITP,VAR(17)),(XCP,VAR(18)),         SUSF0270
     5           (YCP,VAR(19)),(ZCP,VAR(20)),(PSIFI,VAR(21)),           SUSF0280
     6           (PSIFID,VAR(22))                                       SUSF0290
      EQUIVALENCE (DU,DER(1)),(DV,DER(2)),(DW,DER(3)),(DP,DER(4)),      SUSF0300
     1           (DQ,DER(5)),(DR,DER(6)),(DDEL1,DER(7)),(DDEL1D,DER(8))SUSF0310
     2          ,(DDEL2,DER(9)),(DDEL2D,DER(10)),(DDEL3,DER(11)),       SUSF0320
     3           (DDEL3D,DER(12)),(DPHIR,DER(13)),(DPHIRD,DER(14)),     SUSF0330
     4           (DTHTTP,DER(15)),(DPHITP,DER(16)),(DPSITP,DER(17)),    SUSF0340
     5           (DXCP,DER(18)),(DYCP,DER(19)),(DZCP,DER(20)),          SUSF0350
     6           (DPSIFI,DER(21)),(DDPSFI,DER(22))                      SUSF0360
      EQUIVALENCE (VAR(9),PHIF),(VAR(10),PHIFD),(DER(9),DPHIF),         SUSF0370
     1           (DER(10),DPHIFD)                                       SUSF0380
      EQUIVALENCE (VAR(13),DEL4),(VAR(14),DEL4D),(DER(13),DDEL4),       SUSF0390
     1           (DER(14),DDEL4D)                                       SUSF0400
      COMMON /DIMV/X1P,X2P,X3P,X4P,Y1P,Y2P,Y3P,Y4P,Z1P,Z2P,Z3P,Z4P,PHI1,SUSF0410
     1            PHI2,PHI3,PHI4,PSI1,PSI2,PSI3,PSI4,CAYW(4),CBYW(4),   SUSF0420
     2            CGYW(4),ZPGI(4),THGI(4),PHGI(4),CPG(4),SPG(4),CTG(4),SUSF0430
     3            STG(4),CAGZ(4),CBGZ(4),CGGZ(4),D1(4),D2(4),D3(4),     SUSF0440
     4            XLM1(4),XLM2(4),XLM3(4),AMTX(3,3),CMTX(3,4),XGPP(4),  SUSF0450
     5            YGPP(4),ZGPP(4),DMATX(10,11),DELTA(4),CAR(4),CBR(4),  SUSF0460
     6            CGR(4),FR(4),HI(4),FC(4),TI(4),AX(4),BX(4),CX(4),     SUSF0470
     7            CTXG(4),UG(4),STXG(4),AY(4),BY(4),CY(4),CPYG(4),      SUSF0480
     8            SPYG(4),VG(4),PSIIP(4),PHICI(4),CAC(4),CBC(4),CGC(4),SUSF0490
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```
9            FCXU(4),FCYU(4),FCZU(4),FS(4),CAXW(4),CBXW(4),CGXW(4)SUSF0500
 COMMON /DIMV/AS(4),BS(4),CS(4),CAS(4),CBS(4),CGS(4),BETP(4),       SUSF0510
1            BETBR(4),FSXU(4),FSYU(4),FSZU(4),FRXU(4),FRYU(4),      SUSF0520
2            FRZU(4),FXU(4),FYU(4),FZU(4),SI(4),F1FI(2),F1RI(2),    SUSF0530
3            F2FI(2),F2RI(2),CAH(4),CBH(4),CGH(4)                   SUSF0540
 DIMENSION XP(4),YP(4),ZP(4),PHII(4),PSII(4)                        SUSF0550
 EQUIVALENCE (XP(1),X1P),(YP(1),Y1P),(ZP(1),Z1P),(PHII(1),PHI1),    SUSF0560
1            (PSII(1),PSI1)                                         SUSF0570
 COMMON /COMP/SUMM,THETN,PHIN,PSIN,PI,RAD,GAM1,GAM2,GAM3,GAM4,GAM5,SUSF0580
1            GAM6,GAM7,GAM8,GAM9,THETT,PHIT,PSIT,ZRO,TRO2,          SUSF0590
2            TFO2,TIZ,RHO2,RHOMUR,AMUF,BMUR,ZPR,TM4,RHMR2,AO2APB,   SUSF0600
3            BO2APB,RFTF,TSO2,RRTS,BROMUR,XMUFO2,AXMFO2,XMTFO4,     SUSF0610
4            XIZR,RTR,RHMR2I,XIXP,XIZP,XIXZP,XIYZP,D1PD2,D1MD2,     SUSF0620
5            ZRD3,ZRD3R,ZFD3R,ZFD12,TIZ2,TG61,DD1P2,DD1M2,RPR,PHRPSUSF0630
6           ,TANTP,SPHTP,CPHTP,SECTP,SFXS,SFYS,SFZS,SNPS,SNTS,      SUSF0640
7            SNPSS,TPR,CAY,CBY,CGY,CAX,CBX,CGX,SFYU,SFXU,SFYUF,     SUSF0650
8            SFYUR,SFZU,COSTH,SINTH,COSPS,SINPS,COSPH,SINPH,ANG1,   SUSF0660
9            ANG2,CPHI,SPHI,CPSI,SPSI,P1,P7,P3,P4,P5,P6,TX,TY,TZ    SUSF0670
 COMMON /COMP/TRH,DISTX,DISTY,DISTD,DISTS,D21,ZETA4,ZETA4D,ZETA3,   SUSF0680
1            ZETA3D,SFZ1,SNPU,SNTU,HCGH1,HCGH2,HCGH3,HCGH4,TERM1,   SUSF0690
2            TERM2,SNPSU,SNPR,HCBH1,HCBH2,HCBH3,HCBH4,HCAH1,HCAH2,SUSF0700
3            HCAH3,HCAH4,UQ,WP,UR,QR,VP,PR,P2,Q2,R2,VR,WQ,PQ,PHIR2SUSF0710
4           ,PHIRD2,RPHRD,GCTH,GSTH,GCTSP,GCTCP,XXX,YYY,IX,IY,XX1,SUSF0720
5            XX2,YY1,YY2,THG1,THG2,PHG1,PHG2,ZZ1,ZZ2,LLL            SUSF0730
 DIMENSION HCAH(4),HCBH(4),HCGH(4)                                  SUSF0740
 EQUIVALENCE (HCAH(1),HCAH1),(HCBH(1),HCBH1),(HCGH(1),HCGH1)        SUSF0750
 COMMON/ADTNL/ U1,U2,U3,U4,V1,V2,V3,V4,W1,W2,W3,W4,                 SUSF0760
1             XIYP,SPHIC,CPHIC,APTCH1,APTCH2,APTCH3,APTCH4,         SUSF0770
2             SLOPE1,SLOPE2,XTRA(300)                               SUSF0780
 DIMENSION UI(4),VI(4),WI(4)                                        SUSF0790
 EQUIVALENCE (UI(1),U1),(VI(1),V1),(WI(1),W1)                       SUSF0800
 DIMENSION APITCH(4)                                                SUSF0810
 EQUIVALENCE (APITCH(1),APTCH1)                                     SUSF0820
 COMMON/APTABL/ APFR(21,2),IAPFR(2),DAPFB,DAPFE,DDAPF,NAPF,         SUSF0830
1               DAPRB,DAPRE,DDAPR,NAPR                              SUSF0840
 DIMENSION APF(21),APR(21)                                          SUSF0850
 EQUIVALENCE (APFR(1,1),APF(1)),(APFR(1,2),APR(1))                  SUSF0860
 EQUIVALENCE (IAPF,IAPFR(1)),(IAPR,IAPFR(2))                        SUSF0870
 COMMON /INSUS/ XIF,RHOF,TSF,PHIFO,PHIFOD,DEL40,DEL40D,ISUS,        SUSF0880
1               AKDS,AKDS1,AKDS2,AKDS3,PHIRC(50),DTHF(50),DTHR(50),SUSF0890
2               NCAMF,NCAMR,NDTHF,NDTHR                             SUSF0900
 COMMON /SUSCMP/ XMURO2,BXMRO2,XMTRO4,ZFO,TSFO2,RHOF2,RHFMUF,       SUSF0910
1                RHF2MF,RF2MF1,RTF,RRTR,D3PD4,D3MD4,D43,DD3P4,      SUSF0920
2                DD3M4,ZFD1RF,ZRD34,RFPF,RPF2M,WFMF,PHFP,PHIF2,     SUSF0930
3                PHIFD2,RPHFD,ZFD1,ZFD2,ZRD4,TPF,SLOPE3,SLOPE4,     SUSF0940
4                PHI3D,PHI4D,DTHF1,DTHF2,DTHR3,DTHR4,DTDD1,         SUSF0950
5                DTDD2,DTDD3,DTDD4,FJF(4),SNPF                      SUSF0960
 DIMENSION DISP(4),VEL(4),F1I(4),F2I(4)                             SUSF0970
 EQUIVALENCE (F1I(1),F1FI(1)),(F2I(1),F2FI(1))                      SUSF0980
C                                                                   SUSF0990
 DO 500 I=1,4                                                       SUSF1000
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      IF(I.GE.3) GO TO 200
      IF(EPSF.LE.0.0) GO TO 10
      IF(ABS(VEL(I)).GE.EPSF) GO TO 10
      F1I(I) = (CFP/EPSF)*VEL(I)
      GO TO 20
   10 F1I(I) = SIGN(CFP,VEL(I))
   20 XLM = 1.0
      TMP = DISP(I)*VEL(I)
      IF(DISP(I).GT.OMEGFE) GO TO 30
      IF(DISP(I).LT.OMEGFC) GO TO 40
      F2I(I) = AKF*DISP(I)
      GO TO 100
   30 IF(TMP.LT.0.0) XLM = XLAMF
      DISP1 = DISP(I)-OMEGFE
      F2I(I) = AKF*DISP(I)+XLM*(AKFE*DISP1+AKFEP*DISP1**3)
      GO TO 100
   40 IF(TMP.LT.0.0) XLM = XLAMF
      DISP1 = DISP(I)-OMEGFC
      F2I(I) = AKF*DISP(I)+XLM*(AKFC*DISP1+AKFCP*DISP1**3)
      GO TO 100
  100 IF(IAPF.EQ.0) GO TO 150
      APITCH(I) = 0.0
      IF(FC(I).EQ.0.0) GO TO 150
      TMP3 = COS(PHII(I))*COS(PSII(I))/12.0
      CALL INTRPL(APF,DAPFB,DAPFE,DDAPF,DISP(I),APC)
      APITCH(I) = -APC*FC(I)*HI(I)*TMP3
  150 ABAR = RFTF*D21
      IF(ISUS.EQ.2) GO TO 105
      IF(I.EQ.2) GO TO 102
      FJF(1) = -SLOPE1*(FYU(1)*HCGH1-FZU(1)*HCBH1) + FYU(1)*DTDD1
      GO TO 103
  102 ABAR = -ABAR
      FJF(2) = -SLOPE2*(FYU(2)*HCGH2-FZU(2)*HCBH2) - FYU(2)*DTDD2
      GO TO 103
  105 ABAR =-RTF*PHIF
      IF(I.EQ.2) ABAR = -ABAR
      FJF(I) = 0.0
  103 SI(I) = BO2APB-CF*VEL(I)-F1I(I)-F2I(I)+ABAR+FJF(I)+APITCH(I)
      GO TO 500
  200 IF(EPSR.LE.0.0) GO TO 210
      IF(ABS(VEL(I)).GE.EPSR) GO TO 210
      F1I(I) = (CRP/EPSR)*VEL(I)
      GO TO 220
  210 F1I(I) = SIGN(CRP,VEL(I))
  220 XLM = 1.0
      TMP = DISP(I)*VEL(I)
      IF(DISP(I).GT.OMEGRE) GO TO 230
      IF(DISP(I).LT.OMEGRC) GO TO 240
      F2I(I) = AKR*DISP(I)
      GO TO 300
  230 IF(TMP.LT.0.0) XLM = XLAMR
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      DISP1 = DISP(I)-OMEGRE
      F2I(I) = AKR*DISP(I)+XLM*(AKRE*DISP1+AKREP*DISP1**3)
      GO TO 300
  240 IF(TMP.LT.0.0) XLM = XLAMR
      DISP1 = DISP(I)-OMEGRC
      F2I(I) = AKR*DISP(I)+XLM*(AKRC*DISP1+AKRCP*DISP1**3)
  300 IF(IAPR.EQ.0) GO TO 350
      APITCH(I) = 0.0
      IF(FC(I).EQ.0.0) GO TO 350
      TMP3 = COS(PHII(I))*COS(PSII(I))/12.0
      CALL INTRPL(APR,DAPRB,DAPRE,DDAPR,DISP(I),APC)
      APITCH(I) =  APC*FC(I)*HI(I)*TMP3
  350 ABAR = RRTR*D43
      IF(ISUS.NE.1) GO TO 305
      IF(I.EQ.4) GO TO 302
      FJF(3) = -SLOPE3*(FYU(3)*HCGH3-FZU(3)*HCBH3) + FYU(3)*DTDD3
      GO TO 303
  302 ABAR = - ABAR
      FJF(4) = -SLOPE4*(FYU(4)*HCGH4-FZU(4)*HCBH4) - FYU(4)*DTDD4
      GO TO 303
  305 ABAR = -RTR*PHIR
      IF(I.EQ.4) ABAR = -ABAR
      FJF(I) = 0.0
  303 SI(I) = AO2APB-CR*VEL(I)-F1I(I)-F2I(I)+ABAR+APITCH(I)+FJF(I)
  500 CONTINUE
      SFZ1 = SI(1)+SI(2)+SI(3)+SI(4)
      RETURN
      END
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      SUBROUTINE TEREAD(I,NNBX,NNBY,NNX,NNY,NZ5T,NERR)
C              HVOSM-VD2 VERSION
C              REVISED OCTOBER 1975   CALSPAN CORPORATION
      COMMON/INPT/PHIO,THETAO,PSIO,PO,QO,RO,XCOP,YCOP,ZCOP,UO,VO,WO,
     1          A,B,DEL1O,DEL2O,DEL3O,PHIRO,DEL1OD,DEL2OD,DEL3OD,
     2          PHIROD,TF,TR,ZF,ZR,RHO,AKRS,XMUR,
     3          XMS,XMUF,XIX,XIY,XIZ,XIXZ,CF,AKF,XLAMF,OMEGF,CFP,EPSF,
     4          RF,CR,AKR,XLAMR,OMEGR,CRP,EPSR,RR,TS,THMAX,DTCOMP,TO,
     5          T1,DTCMP1,DTPRNT,MODE,EBAR,EM,AAA,HMAX,HMIN,BET,G,
     6          HED(36),DADE(3),XIR,X1,Y1,Z1,X2,Y2,Z2,PHIC(50),DELB,
     7          DELE,DDEL,NDEL,PSIF(50),TQF(50),TQR(50),TB,TE,TINCR,
     8          NZTAB,NZ5,XBDRY(4,5),PSBDRY(4,5),YBDRY(2,5),NBX(5),
     9          NBY(5),NTBL1,NTBL2,NTBL3,ZGP(21,21,5)
      COMMON/INPT/XB(5),XE(5),XINCR(5),NX(5),YB(5),YE(5),YINCR(5),NY(5),
     1        XXZGP5(21),YYZGP5(21),AMUG(5),PSBDRO(4,5),UVWMIN,PQRMIN
      DIMENSION DUM(18)
      LSEQ = 0
      IF(NNBX.LE.0) GO TO 10
      READ(2,2000) (DUM(K),K=1,9),NSEQ,NCARD
 2000 FORMAT(9F8.0,2I4)
      IF(NSEQ.LT.LSEQ) GO TO 98
      LSEQ = NSEQ
      IF(NNBX.GT.4) GOTO 98
      DO 11 K=1,NNBX
   11 XBDRY(K,I) = DUM(K)
      READ(2,2000) (DUM(K),K=1,9),NSEQ,NCARD
      IF(NSEQ.LT.LSEQ) GO TO 98
      LSEQ = NSEQ
      DO 12 K=1,NNBX
   12 PSBDRO(K,I) = DUM(K)
   10 IF(NNBY.LE.0) GO TO 20
      IF(NNBY.GT.2) GO TO 98
      READ(2,2000) (DUM(K),K=1,9),NSEQ,NCARD
      IF(NSEQ.LT.LSEQ) GO TO 98
      LSEQ = NSEQ
      DO 13 K=1,NNBY
   13 YBDRY(K,I) = DUM(K)
   20 NYCDS = (NNY-1)/9+1
      DO 30 J=1,NNX
      M = 0
      DO 40 K=1,NYCDS
      READ(2,2000) (DUM(N),N=1,9),NSEQ,NCARD
      IF(NSEQ.LT.LSEQ) GO TO 98
      LSEQ = NSEQ
      DO 50 N=1,9
      M = M+1
      ZGP(J,M,I) = DUM(N)
      IF(M.GE.NNY) GO TO 30
   50 CONTINUE
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40 CONTINUE                                                           TERE0500
30 CONTINUE                                                           TERE0510
   IF(NZ5T.EQ.0) GO TO 99                                             TERE0520
   M = 0                                                              TERE0530
   DO 60 K=1,NYCDS                                                    TERE0540
   READ(2,2000) (DUM(N),N=1,9),NSEQ,NCARD                             TERE0550
   IF(NSEQ.LT.LSEQ) GO TO 98                                          TERE0560
   LSEQ = NSEQ                                                        TERE0570
   DO 61 N=1,9                                                        TERE0580
   M = M+1                                                            TERE0590
   YYZGP5(M) = DUM(N)                                                 TERE0600
   IF(M.GE.NNY) GO TO 70                                              TERE0610
61 CONTINUE                                                           TERE0620
60 CONTINUE                                                           TERE0630
70 NXCDS = (NNX-1)/9 + 1                                              TERE0640
   M = 0                                                              TERE0650
   DO 71 K=1,NXCDS                                                    TERE0660
   READ(2,2000) (DUM(N),N=1,9),NSEQ,NCARD                             TERE0670
   IF(NSEQ.LT.LSEQ) GO TO 98                                          TERE0680
   LSEQ = NSEQ                                                        TERE0690
   DO 72 N=1,9                                                        TERE0700
   M = M+1                                                            TERE0710
   XXZGP5(M) = DUM(N)                                                 TERE0720
   IF(M.GE.NNX) GO TO 99                                              TERE0730
72 CONTINUE                                                           TERE0740
71 CONTINUE                                                           TERE0750
98 NERR = 1                                                           TERE0760
99 RETURN                                                             TERE0770
   END                                                                TERE0780
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      SUBROUTINE TIRFR                                                  TIRF0010
C             HVOSM-VD2 VERSION                                         TIRF0020
C             REVISED OCTOBER 1975   CALSPAN CORPORATION                TIRF0030
      COMMON/INPT/PHIO,THETAO,PSIO,PO,QO,RO,XCOP,YCOP,ZCOP,UO,VO,WO,    TIRF0040
     1          A,B,DEL10,DEL20,DEL30,PHIRO,DEL10D,DEL20D,DEL30D,       TIRF0050
     2          PHIROD,TF,TR,ZF,ZR,RHO,AKRS,XMUR,                       TIRF0060
     3          XMS,XMUF,XIX,XIY,XIZ,XIXZ,CF,AKF,XLAMF,OMEGF,CFP,EPSF,TIRF0070
     4          RF,CR,AKR,XLAMR,OMEGR,CRP,EPSR,RR,TS,THMAX,DTCOMP,TO,   TIRF0080
     5          T1,DTCMP1,DTPRNT,MODE,EBAR,EM,AAA,HMAX,HMIN,BET,G,      TIRF0090
     6          HED(36),DADE(3),XIR,X1,Y1,Z1,X2,Y2,Z2,PHIC(50),DELB,    TIRF0100
     7          DELE,DDEL,NDEL,PSIF(50),TQF(50),TQR(50),TB,TE,TINCR,    TIRF0110
     8          NZTAB,NZ5,XBDRY(4,5),PSBDRY(4,5),YBDRY(2,5),NBX(5),     TIRF0120
     9          NBY(5),NTBL1,NTBL2,NTBL3,ZGP(21,21,5)                   TIRF0130
      COMMON/INPT/XB(5),XE(5),XINCR(5),NX(5),YB(5),YE(5),YINCR(5),NY(5),TIRF0140
     1        XXZGP5(21),YYZGP5(21),AMUG(5),PSBDRO(4,5),UVWMIN,PQRMIN TIRF0150
      COMMON /INTG/NEQ,T,DT,VAR(50),DER(50)                             TIRF0160
      EQUIVALENCE (U,VAR(1)),(V,VAR(2)),(W,VAR(3)),(P,VAR(4)),(Q,VAR(5))TIRF0170
     1        ,(R,VAR(6)),(DEL1,VAR(7)),(DEL1D,VAR(8)),(DEL2,VAR(9)),TIRF0180
     2          (DEL2D,VAR(10)),(DEL3,VAR(11)),(DEL3D,VAR(12)),         TIRF0190
     3          (PHIR,VAR(13)),(PHIRD,VAR(14)),(THETTP,VAR(15)),        TIRF0200
     4          (PHITP,VAR(16)),(PSITP,VAR(17)),(XCP,VAR(18)),          TIRF0210
     5          (YCP,VAR(19)),(ZCP,VAR(20)),(PSIFI,VAR(21)),            TIRF0220
     6          (PSIFID,VAR(22))                                        TIRF0230
      EQUIVALENCE (DU,DER(1)),(DV,DER(2)),(DW,DER(3)),(DP,DER(4)),      TIRF0240
     1          (DQ,DER(5)),(DR,DER(6)),(DDEL1,DER(7)),(DDEL1D,DER(8))TIRF0250
     2        ,(DDEL2,DER(9)),(DDEL2D,DER(10)),(DDEL3,DER(11)),         TIRF0260
     3          (DDEL3D,DER(12)),(DPHIR,DER(13)),(DPHIRD,DER(14)),      TIRF0270
     4          (DTHTTP,DER(15)),(DPHITP,DER(16)),(DPSITP,DER(17)),     TIRF0280
     5          (DXCP,DER(18)),(DYCP,DER(19)),(DZCP,DER(20)),           TIRF0290
     6          (DPSIFI,DER(21)),(DDPSFI,DER(22))                       TIRF0300
      COMMON /DIMV/X1P,X2P,X3P,X4P,Y1P,Y2P,Y3P,Y4P,Z1P,Z2P,Z3P,Z4P,PHI1,TIRF0310
     1          PHI2,PHI3,PHI4,PSI1,PSI2,PSI3,PSI4,CAYW(4),CBYW(4),     TIRF0320
     2          CGYW(4),ZPGI(4),THGI(4),PHGI(4),CPG(4),SPG(4),CTG(4),TIRF0330
     3          STG(4),CAGZ(4),CBGZ(4),CGGZ(4),D1(4),D2(4),D3(4),       TIRF0340
     4          XLM1(4),XLM2(4),XLM3(4),AMTX(3,3),CMTX(3,4),XGPP(4),    TIRF0350
     5          YGPP(4),ZGPP(4),DMATX(10,11),DELTA(4),CAR(4),CBR(4),    TIRF0360
     6          CGR(4),FR(4),HI(4),FC(4),TI(4),AX(4),BX(4),CX(4),       TIRF0370
     7          CTXG(4),UG(4),STXG(4),AY(4),BY(4),CY(4),CPYG(4),        TIRF0380
     8          SPYG(4),VG(4),PSIIP(4),PHICI(4),CAC(4),CBC(4),CGC(4),TIRF0390
     9          FCXU(4),FCYU(4),FCZU(4),FS(4),CAXW(4),CBXW(4),CGXW(4)TIRF0400
      COMMON /DIMV/AS(4),BS(4),CS(4),CAS(4),CBS(4),CGS(4),BETP(4),      TIRF0410
     1          BETBR(4),FSXU(4),FSYU(4),FSZU(4),FRXU(4),FRYU(4),       TIRF0420
     2          FRZU(4),FXU(4),FYU(4),FZU(4),SI(4),F1FI(2),F1RI(2),     TIRF0430
     3          F2FI(2),F2RI(2),CAH(4),CBH(4),CGH(4)                    TIRF0440
      DIMENSION XP(4),YP(4),ZP(4),PHII(4),PSII(4)                       TIRF0450
      EQUIVALENCE (XP(1),X1P),(YP(1),Y1P),(ZP(1),Z1P),(PHII(1),PHI1),   TIRF0460
     1          (PSII(1),PSI1)                                          TIRF0470
      COMMON /COMP/SUMM,THETN,PHIN,PSIN,PI,RAD,GAM1,GAM2,GAM3,GAM4,GAM5,TIRF0480
     1          GAM6,GAM7,GAM8,GAM9,THETT,PHIT,PSIT,ZRO,TRO2,           TIRF0490
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2           TFO2,TIZ,RHO2,RHOMUR,AMUF,BMUR,ZPR,TM4,RHMR2,AO2APB, TIRF0500
3           BO2APB,RFTF,TSO2,RRTS,BROMUR,XMUFO2,AXMFO2,XMTFO4,    TIRF0510
4           XIZR,RTR,RHMR2I,XIXP,XIZP,XIXZP,XIYZP,D1PD2,D1MD2,    TIRF0520
5           ZRD3,ZRD3R,ZFD3R,ZFD12,TIZ2,TG61,DD1P2,DD1M2,RPR,PHRPTIRF0530
6          ,TANTP,SPHTP,CPHTP,SECTP,SFXS,SFYS,SFZS,SNPS,SNTS,     TIRF0540
7           SNPSS,TPR,CAY,CBY,CGY,CAX,CBX,CGX,SFYU,SFXU,SFYUF,    TIRF0550
8           SFYUR,SFZU,COSTH,SINTH,COSPS,SINPS,COSPH,SINPH,ANG1,  TIRF0560
9           ANG2,CPHI,SPHI,CPSI,SPSI,P1,P7,P3,P4,P5,P6,TX,TY,TZ   TIRF0570
 COMMON /COMP/TRH,DISTX,DISTY,DISTD,DISTS,D21,ZETA4,ZETA4D,ZETA3,  TIRF0580
1           ZETA3D,SFZ1,SNPU,SNTU,HCGH1,HCGH2,HCGH3,HCGH4,TERM1,  TIRF0590
2           TERM2,SNPSU,SNPR,HCBH1,HCBH2,HCBH3,HCBH4,HCAH1,HCAH2,TIRF0600
3           HCAH3,HCAH4,UQ,WP,UR,QR,VP,PR,P2,Q2,R2,VR,WQ,PQ,PHIR2TIRF0610
4          ,PHIRD2,RPHRD,GCTH,GSTH,GCTSP,GCTCP,XXX,YYY,IX,IY,XX1,TIRF0620
5           XX2,YY1,YY2,THG1,THG2,PHG1,PHG2,ZZ1,ZZ2,LLL           TIRF0630
 DIMENSION HCAH(4),HCBH(4),HCGH(4)                                 TIRF0640
 EQUIVALENCE (HCAH(1),HCAH1),(HCBH(1),HCBH1),(HCGH(1),HCGH1)       TIRF0650
 COMMON /COMPN/ FRSP(4),FRCP(4),ICBHIT,JCBHIT,                     TIRF0660
1             DPSINT,TANPC1,TANPC2,PHIC1R,PHIC2R,AMUCMP,PHI1D,    TIRF0670
2             PHI2D,LCB1(4),LCB2(4),IHIT,AJMTX(3,3),BMTX(3,3),    TIRF0680
3             SFRX(4),SFRY(4),SFRZ(4),T1PSI,T2PSI,XMUGI(4)        TIRF0690
 LOGICAL LCB1,LCB2                                                 TIRF0700
 COMMON /INPT4/ FIDJ(2),FIWJ(2),ARBR(2),NXUGMU,NXFRCP,XXUGMU(6),   TIRF0710
A             XXFRCP(6),XMUMAT(6,6,4),XMXPMT(6,6,4),              TIRF0720
B             XMXSMT(6,6,4),SLIPMT(6,6,4),CT(4),XMUM(4),          TIRF0730
C             XMUXP(4),XMUXS(4),RRMC(4),RRM(4),COMEN4             TIRF0740
 EQUIVALENCE (FIDJ(1),FIDJF),(FIDJ(2),FIDJR),(FIWJ(1),FIWJF)       TIRF0750
 EQUIVALENCE (FIWJ(2),FIWJR),(ARBR(1),ARBRF),(ARBR(2),ARBRR)       TIRF0760
 COMMON /COMP4/FIDAR(2),FIDIW(2),FIDWR2(2),SPHICI(4),CPHICI(4),    TIRF0770
1            TIHI(4),ARBRI(4), PSITEM(4),SLPFAC(4),DTSTEP,DTTEST,TIRF0780
2      DTINT,TWOPIR,FRTEST(4),XMUI(4),FRCPMU(4),HRTERM,SLIP(4),    TIRF0790
3            SLIPT(4),RHOS(4),EPSS(4),TERMP(4),TERMB(4),TERM(4),  TIRF0800
4            EPSSFC,FSXFAC(4),FSYFAC(4),FSZFAC(4),FRXFAC(4),      TIRF0810
5            FRYFAC(4),FRZFAC(4),FCXFAC(4),FCYFAC(4),FCZFAC(4),   TIRF0820
6            SFCDTR(4),SFSDTR(4),SFRCPR(4),SSLIP(4),FCAV(4),      TIRF0830
7            FSAV(4),FRCPAV(4),SLIPAV(4),RPSSM(4),FCSLSM(4),      TIRF0840
8         ARTQ6(4),TQFAC(4),ARFAC1(2),ARFAC2(2),RPSFA(2),RPSFB(2),TIRF0850
9         RPSFC(2),RPSFD(2),HRPSFA(4),HRPSFB(4),HRPSFC(4),STEPD   TIRF0860
 COMMON /COMP4/  XBRAK(16),IUVS(4),IUVB(4),IRPS,IDTCNT,ISTEP,ISTOP TIRF0870
 LOGICAL  IUVS,IUVB,IRPS                                           TIRF0880
 COMMON/INPT5/ IBTYP(2),AK1,AK2,PONE,PTWO,PZERO(2),GN(16,2),ZETAB, TIRF0890
1            CONE,CTWO,CTHREE,TAUA,TAUO(4),TLF(51),TTAU(51),      TIRF0900
2            TRPME(12),TWOT(12),TCT(12),TT(101),TPC(101),TTR(101)TIRF0910
3           ,TTS(101),BTLF,ETLF,DTLF,NTLF,BRPM,ERPM,NRPM,         TIRF0920
4            BTT,ETT,DTT,NTT1,NTT2,NTT3,NTTS,XINPT5(9)            TIRF0930
 COMMON/COMP5/ TAU(4),TQD(2),TQB(4),PP(2),TLAMB(2),PC,RWDRIV,JDEND,TIRF0940
1            NBTYP,ARFAC3(2),RPSFE(2),RHOSMX(3),SLIPMX(3),SLIPP,  TIRF0950
2            RHOMAX,RHOSAV(4),SRHOS(4),UGW(4),ABSUGW(4),VECS,     TIRF0960
3            DELTAE,PIO15R,COMEN5,TQE,RPME                        TIRF0970
 COMMON /INTR/ NEQR,TIMR,DTR,VARR(12),DERR(12)                     TIRF0980
 DIMENSION RPSI(4),DRPSI(4)                                        TIRF0990
 EQUIVALENCE(VARR(1),RPSI(1)),(DERR(1),DRPSI(1))                   TIRF1000
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C                                                                         TIRF1010
C      VARIABLES NO LONGER USED INCLUDE TQF(50),TQR(50),TI(4),TIHI(4)     TIRF1020
C                                                                         TIRF1030
C                                                                         TIRF1040
C                                                                         TIRF1050
C     FOR ISTEP=1, TIME T IS A HALF-INTERVAL AHEAD OF CLOSING TIME FOR    TIRF1060
C      'OUTER' INTEGRATION, SO TABLE VALUES ARE FOUND AT TIME T,          TIRF1070
C      AND THE INTEGRATED VARIABLES ARE SET AT THIS NEW HALF INTERVAL,    TIRF1080
C      USING THE DERIVATIVE VALUES COMPUTED AT CLOSE OF PREVIOUS          TIRF1090
C      INTERVAL, SAID DERIVATIVES HAVING BEEN COMPUTED WITH THE FINAL     TIRF1100
C      VARIABLE VALUES FOR THE INTEGRATION OF THE PREVIOUS INTERVAL.      TIRF1110
C        FOR ISTEP=2, TIME T IS SAME AS FOR ISTEP=1, AND THE INTEGRATED   TIRF1120
C       VARIABLES ARE REEVALUATED, USING THE DERIVATIVES FROM ISTEP=1.    TIRF1130
C        FOR ISTEP=3, TIME T IS A FULL INTERVAL AHEAD,AND THE INTEGRATEDTIRF1140
C      VARIABLES ARE REEVALUATED,USING THE DERIVATIVES FROM ISTEP=2.      TIRF1150
C        FOR ISTEP=4, TIME T IS SAME AS FOR ISTEP=3,AND INTEGRATED        TIRF1160
C      VARIABLES ARE UPDATED FINALLY BY THE AVERAGING.  NEW DERIVATIVES   TIRF1170
C      USING THESE FINAL VALUES OF THE INTEGRATED VARIABLES ARE           TIRF1180
C      COMPUTED, READY FOR NEXT INTERVAL.                                 TIRF1190
C                                                                         TIRF1200
      DO 15 I=1,4                                                         TIRF1210
      SPHICI(I) = CAYW(I)*CAGZ(I)+CBYW(I)*CBGZ(I)+CGYW(I)*CGGZ(I)         TIRF1220
      PHICI(I)  = ARSIN(SPHICI(I))                                        TIRF1230
   15 CONTINUE                                                            TIRF1240
      ISTEP = ISTEP + 1                                                   TIRF1250
      IF(ISTEP.EQ.2.OR.ISTEP.EQ.4) RETURN                                 TIRF1260
C           RETAIN FC,FS, RPSI, DRPSI AS COMPUTED TO THE HALF-STEP ONCE,TIRF1270
C                 TO THE SECOND HALF-STEP ONCE.                           TIRF1280
      STEPD = 1.0                                                         TIRF1290
      IF (MODE -1)  17,16,17                                              TIRF1300
   16 STEPD = 0.5                                                         TIRF1310
   17 DO 21 I=1,4                                                         TIRF1320
      FC(I)    = 0.0                                                      TIRF1330
      FS(I)    = 0.0                                                      TIRF1340
      FRCP(I) = 0.0                                                       TIRF1350
      FCXU(I) = 0.0                                                       TIRF1360
      FCYU(I) = 0.0                                                       TIRF1370
      FCZU(I) = 0.0                                                       TIRF1380
      FRXU(I) = 0.0                                                       TIRF1390
      FRYU(I) = 0.0                                                       TIRF1400
      FRZU(I) = 0.0                                                       TIRF1410
      FSXU(I) = 0.0                                                       TIRF1420
      FSYU(I) = 0.0                                                       TIRF1430
      FSZU(I) = 0.0                                                       TIRF1440
      FXU(I)  = 0.0                                                       TIRF1450
      FYU(I)  = 0.0                                                       TIRF1460
      FZU(I)  = 0.0                                                       TIRF1470
      SFCDTR(I) = 0.0                                                     TIRF1480
      SFSDTR(I) = 0.0                                                     TIRF1490
      SFRCPR(I) = 0.0                                                     TIRF1500
      SSLIP (I) = 0.0                                                     TIRF1510
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      FCAV  (I) = 0.0
      FSAV  (I) = 0.0
      FRCPAV(I) = 0.0
      SLIPAV(I) = 0.0
      SRHOS(I) = 0.0
      RHOSAV(I) = 0.0
C       NOTE THAT RPSSM  AND FCSLSM ARE NOT CHANGED.
C            FORMERLY, TIRFRC(I) WAS CALLED FROM VGORNT SEPARATELY FOR
C          EACH WHEEL. THE SUM OF THE FORCES FOR ALL WHEELS WAS THEREFOR
C             NOT ZEROED IN TIRFRC BUT IN VPOS FOR EACH RUNGE-KUTTA STEP
C             SFXU,SFYU,SFZU
   21 CONTINUE
      SFXU = 0.0
      SFYU = 0.0
      SFZU = 0.0
      DO 23 I=1,4
      IF (FR(I).NE.0.0) GO TO 30
      IF(TQB(I).NE.0.0) GO TO 30
   23 CONTINUE
      RETURN
C            AT 30 RADIAL TIRE FORCE IS NON-ZERO FOR AT LEAST ONE WHEEL
C              OR TORQUE IS NON-ZERO FOR AT LEAST ONE WHEEL.
   30 DO 31 I=1,4
      CPHICI(I) = COS(PHICI(I))
      PSITEM(I) = PSIIP(I)* SIGN(1.0,UG(I))
C           UGW(I) IS VELOCITY IN WHEEL PLANE
      UGW(I) = UG(I) * COS(PSIIP(I))  + VG(I) * SIN(PSIIP(I))
      ABSUGW(I) = ABS(UGW(I))
C      IUVS FOR SLIP TEST,  IUVB FOR FS  (SIDE FORCE) TEST
      IUVS(I) = .FALSE.
      IF( ABSUGW(I)  .GE. 0.5) IUVS(I) = .TRUE.
      IUVB(I) = .FALSE.
      IF(ABS(UG(I)).GT.0.5  .OR. ABS(VG(I)).GT.0.5) IUVB(I) = .TRUE.
      TERM(I) = 0.0
      IF(.NOT.IUVB(I)) GO TO 301
      IF(UG(I).NE.0.0.OR.VG(I).NE.0.0) TERM(I)=ATAN2(VG(I),ABS(UG(I)))
  301  TERMP1 = TAN(TERM(I)-PSITEM(I))
      TERMP(I)= TERMP1 * TERMP1
      TERMB(I)= PHICI(I) - 0.6366*PHICI(I) * ABS(PHICI(I))
      FSXFAC(I) =  AMTX(1,1)*CAS(I)+AMTX(2,1)*CBS(I)+AMTX(3,1)*CGS(I)
      FSYFAC(I) =  AMTX(1,2)*CAS(I)+AMTX(2,2)*CBS(I)+AMTX(3,2)*CGS(I)
      FSZFAC(I) =  AMTX(1,3)*CAS(I)+AMTX(2,3)*CBS(I)+AMTX(3,3)*CGS(I)
      FRXFAC(I) =  AMTX(1,1)*CAGZ(I)+AMTX(2,1)*CBGZ(I)+AMTX(3,1)*CGGZ(I)
      FRYFAC(I) =  AMTX(1,2)*CAGZ(I)+AMTX(2,2)*CBGZ(I)+AMTX(3,2)*CGGZ(I)
      FRZFAC(I) =  AMTX(1,3)*CAGZ(I)+AMTX(2,3)*CBGZ(I)+AMTX(3,3)*CGGZ(I)
      FCXFAC(I) =  AMTX(1,1)*CAC(I) +AMTX(2,1)*CBC(I) +AMTX(3,1)*CGC(I)
      FCYFAC(I) =  AMTX(1,2)*CAC(I) +AMTX(2,2)*CBC(I) +AMTX(3,2)*CGC(I)
      FCZFAC(I) =  AMTX(1,3)*CAC(I) +AMTX(2,3)*CBC(I) +AMTX(3,3)*CGC(I)
   31 CONTINUE
      DO 33  I=1,4
      SLPFAC(I) = 0.0
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```
      IF( ABSUGW(I)  .LE. 0.5) GO TO 33
      SLPFAC(I) = HI(I) / UGW(I)
   33 CONTINUE
      IF(IRPS) GO TO 35
      IRPS = .TRUE.
      DO 34 I=1,4
      RPSI(I) = 0.0
      IF (SLPFAC(I) .EQ. 0.0) GO TO 34
      RPSI(I) = 1.0/SLPFAC(I)
   34 CONTINUE
C             GET DRPSI USING RPSI COMPUTED ABOVE.
       NTRA = 1
      CALL DAUXR(NTRA)
   35 DTSTEP = DT *STEPD
      DTR = DTSTEP
      DTTEST = 1.0E20
      DO 38 I=1,4
      IF (DRPSI(I) .EQ.0.0 .OR. RPSI(I) .EQ.0.0) GO TO 38
   36 DTINT = ABS (RPSI(I)/DRPSI(I))
      IF(DTINT - DTTEST) 37,38,38
   37 DTTEST = DTINT
   38 CONTINUE
C              DTTEST MUST NOT BE ZERO.
      IDTCNT = 1
C
C
   50 IF (DTR  - COMEN4*DTTEST) 52,52,51
   51 DTR = 0.5 * DTR
      IDTCNT = 2*IDTCNT
      IF (IDTCNT .GE.32) GO TO 52
      GO TO 50
   52 IF(DTR.GT.0.0) GO TO 55
      ISTOP = 1
      GO TO 64
   55  NTRA = 2
      CALL DAUXR(NTRA)
      DO 58 I=1,4
      RPSI(I) = RPSI(I) + DRPSI(I)*DTR
C
C  COMPUTE CHANGE IN BRAKE TEMPERATURE AND ADD TO PREVIOUS VALUE FOR
C  BRAKE TEMPERATURE
C               NOTE, TQB(I)*RPSI(I) IS NECESSARILY NEGATIVE,THE SIGNS HAV
C              BEEN SET OPPOSITE. SEE SUBROUTINE ADJTQB,CALLED BY DAUXR.
C
       JFR = 1
       IF(I.GT.2) JFR = 2
      UG36 = 0.0
      ABSUG = ABS(UG(I))
      IF(ABSUG.GT.0.0) UG36 = ABSUG**(0.36)
      DELTAE =(-(TQB(I)*RPSI(I))/777.8  -GN(14,JFR)*UG36 *
     1           ( TAU(I) - TAUA)) * DTR
```

```
      TAU(I)    = TAU(I)    + (DELTAE/(GN(15,JFR)*GN(16,JFR)))
   58 CONTINUE
      IDTCNT = IDTCNT - 1
C     IF(ISTOP) 64,59,64
   59 DO 70 I=1,4
      SFCDTR(I) = SFCDTR(I) +  FC(I) *DTR
      SFSDTR(I) = SFSDTR(I) +  FS(I) *DTR
      SFRCPR(I) = SFRCPR(I) + FRCP(I) * DTR
      SSLIP(I) = SSLIP(I) + SLIP(I) * DTR
      SRHOS(I) = SRHOS(I) + RHOS(I) * DTR
C     RPSSM AND FCSLSM FOR PRINT ONLY.
      RPSSM(I) = RPSSM(I) - (TOB(I) * RPSI(I)) * DTR
      IF(SLPFAC(I).EQ.0.0) GO TO 70
       XTEM = ABS(FC(I)*HI(I)/(12.0*SLPFAC(I)))
      FCSLSM(I) = FCSLSM(I) + (SLIP(I) * XTEM) * DTR
   70 CONTINUE
      IF(IDTCNT) 62,62,55
C
   62 DO 75 I = 1,4
      FCAV  (I) = SFCDTR(I) / DTSTEP
      FC(I) = FCAV  (I)
      RHOSAV(I) = SRHOS(I)/DTSTEP
      FSAV  (I) = SFSDTR(I) / DTSTEP
      FS(I) = FSAV  (I)
      FRCPAV(I) = SFRCPR(I) / DTSTEP
      FRCP(I) = FRCPAV(I)
C                   SLIPAV NOT YET USED.
      SLIPAV(I) = SSLIP(I) / DTSTEP
      FSXU(I)  = FS(I) * FSXFAC(I)
      FSYU(I)  = FS(I) * FSYFAC(I)
      FSZU(I)  = FS(I) * FSZFAC(I)
      FRXU(I)  =-FRCP(I) * FRXFAC(I)
      FRYU(I)  =-FRCP(I) * FRYFAC(I)
      FRZU(I)  =-FRCP(I) * FRZFAC(I)
      FCXU(I)  = FC(I) * FCXFAC(I)
      FCYU(I)  = FC(I) * FCYFAC(I)
      FCZU(I)  = FC(I) * FCZFAC(I)
      FXU(I) = FRXU(I) + FCXU(I) +FSXU(I)
      SFXU   = SFXU + FXU(I)
      FYU(I) = FRYU(I) + FCYU(I) +FSYU(I)
      SFYU   = SFYU + FYU(I)
      FZU(I) = FRZU(I) + FCZU(I) +FSZU(I)
      SFZU   = SFZU + FZU(I)
   75 CONTINUE
C
   64 RETURN
C       ISTOP.NE.0 CAUSES PRINTING OF OUTPUT UP TO CURRENT RUNGE-KUTTA
C         INTERVAL, MESSAGE, AND TERMINATION OF THIS RUN AT END OF THIS
C         INTERVAL IN THE MAIN PROGRAM.
C
C
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C  63 IF (ISTOP) 64,65,64                                               TIRF3050
C             AT 64 TEMPORARY ERROR STOP.                               TIRF3060
C  64 CALL OUTPUT(2)                                                    TIRF3070
C     CALL PLOTTP(3)                                                    TIRF3080
C     CALL ABDUMP                                                       TIRF3090
C     SUBR ABDUMP CAUSES 'ABNORMAL END' AND DUMP ON OUR OPERATING SYSTEMTIRF3100
C  65 RETURN                                                            TIRF3110
      END                                                               TIRF3120
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      SUBROUTINE TMCNST                                                 TMCN0010
C              HVOSM-VD2 VERSION                                        TMCN0020
C              REVISED OCTOBER 1975   CALSPAN CORPORATION               TMCN0030
      COMMON/INPT/PHIO,THETAO,PSIO,PO,QO,RO,XCOP,YCOP,ZCOP,UO,VO,WO,    TMCN0040
     1          A,B,DEL10,DEL20,DEL30,PHIRO,DEL10D,DEL20D,DEL30D,       TMCN0050
     2          PHIROD,TF,TR,ZF,ZR,RHO,AKRS,XMUR,                       TMCN0060
     3          XMS,XMUF,XIX,XIY,XIZ,XIXZ,CF,AKF,XLAMF,OMEGF,CFP,EPSF,TMCN0070
     4          RF,CR,AKR,XLAMR,OMEGR,CRP,EPSR,RR,TS,THMAX,DTCOMP,TO,  TMCN0080
     5          T1,DTCMP1,DTPRNT,MODE,EBAR,EM,AAA,HMAX,HMIN,BET,G,     TMCN0090
     6          HED(36),DADE(3),XIR,X1,Y1,Z1,X2,Y2,Z2,PHIC(50),DELB,   TMCN0100
     7          DELE,DDEL,NDEL,PSIF(50),TQF(50),TQR(50),TB,TE,TINCR,   TMCN0110
     8          NZTAB,NZ5,XBDRY(4,5),PSBDRY(4,5),YBDRY(2,5),NBX(5),    TMCN0120
     9          NBY(5),NTBL1,NTBL2,NTBL3,ZGP(21,21,5)                   TMCN0130
      COMMON/INPT/XB(5),XE(5),XINCR(5),NX(5),YB(5),YE(5),YINCR(5),NY(5),TMCN0140
     1       XXZGP5(21),YYZGP5(21),AMUG(5),PSBDRO(4,5),UVWMIN,PQRMIN TMCN0150
      COMMON /INTG/NEQ,T,DT,VAR(50),DER(50)                             TMCN0160
      EQUIVALENCE (U,VAR(1)),(V,VAR(2)),(W,VAR(3)),(P,VAR(4)),(Q,VAR(5))TMCN0170
     1        ,(R,VAR(6)),(DEL1,VAR(7)),(DEL1D,VAR(8)),(DEL2,VAR(9)),TMCN0180
     2          (DEL2D,VAR(10)),(DEL3,VAR(11)),(DEL3D,VAR(12)),         TMCN0190
     3          (PHIR,VAR(13)),(PHIRD,VAR(14)),(THETTP,VAR(15)),        TMCN0200
     4          (PHITP,VAR(16)),(PSITP,VAR(17)),(XCP,VAR(18)),          TMCN0210
     5          (YCP,VAR(19)),(ZCP,VAR(20)),(PSIFI,VAR(21)),            TMCN0220
     6          (PSIFID,VAR(22))                                        TMCN0230
      EQUIVALENCE (DU,DER(1)),(DV,DER(2)),(DW,DER(3)),(DP,DER(4)),      TMCN0240
     1          (DQ,DER(5)),(DR,DER(6)),(DDEL1,DER(7)),(DDEL1D,DER(8))TMCN0250
     2        ,(DDEL2,DER(9)),(DDEL2D,DER(10)),(DDEL3,DER(11)),         TMCN0260
     3          (DDEL3D,DER(12)),(DPHIR,DER(13)),(DPHIRD,DER(14)),      TMCN0270
     4          (DTHTTP,DER(15)),(DPHITP,DER(16)),(DPSITP,DER(17)),     TMCN0280
     5          (DXCP,DER(18)),(DYCP,DER(19)),(DZCP,DER(20)),           TMCN0290
     6          (DPSIFI,DER(21)),(DDPSFI,DER(22))                       TMCN0300
      EQUIVALENCE (VAR(9),PHIF),(VAR(10),PHIFD),(DER(9),DPHIF),         TMCN0310
     1          (DER(10),DPHIFD)                                        TMCN0320
      EQUIVALENCE (VAR(13),DEL4),(VAR(14),DEL4D),(DER(13),DDEL4),       TMCN0330
     1          (DER(14),DDEL4D)                                        TMCN0340
      COMMON /COMP/SUMM,THETN,PHIN,PSIN,PI,RAD,GAM1,GAM2,GAM3,GAM4,GAM5,TMCN0350
     1          GAM6,GAM7,GAM8,GAM9,THETT,PHIT,PSIT,ZRO,TRO2,           TMCN0360
     2           TFO2,TIZ,RHO2,RHOMUR,AMUF,BMUR,ZPR,TM4,RHMR2,AO2APB,  TMCN0370
     3           BO2APB,RFTF,TSO2,RRTS,BROMUR,XMUFO2,AXMFO2,XMTFO4,    TMCN0380
     4           XIZR,RTR,RHMR2I,XIXP,XIZP,XIXZP,XIYZP,D1PD2,D1MD2,    TMCN0390
     5           ZRD3,ZRD3R,ZFD3R,ZFD12,TIZ2,TG61,DD1P2,DD1M2,RPR,PHRPTMCN0400
     6          ,TANTP,SPHTP,CPHTP,SECTP,SFXS,SFYS,SFZS,SNPS,SNTS,     TMCN0410
     7           SNPSS,TPR,CAY,CBY,CGY,CAX,CBX,CGX,SFYU,SFXU,SFYUF,    TMCN0420
     8           SFYUR,SFZU,COSTH,SINTH,COSPS,SINPS,COSPH,SINPH,ANG1,  TMCN0430
     9           ANG2,CPHI,SPHI,CPSI,SPSI,P1,P7,P3,P4,P5,P6,TX,TY,TZ   TMCN0440
      COMMON /COMP/TRH,DISTX,DISTY,DISTD,DISTS,D21,ZETA4,ZETA4D,ZETA3,  TMCN0450
     1           ZETA3D,SFZ1,SNPU,SNTU,HCGH1,HCGH2,HCGH3,HCGH4,TERM1,  TMCN0460
     2           TERM2,SNPSU,SNPR,HCBH1,HCBH2,HCBH3,HCBH4,HCAH1,HCAH2,TMCN0470
     3           HCAH3,HCAH4,UQ,WP,UR,QR,VP,PR,P2,Q2,R2,VR,WQ,PQ,PHIR2TMCN0480
     4          ,PHIRD2,RPHRD,GCTH,GSTH,GCTSP,GCTCP,XXX,YYY,IX,IY,XX1,TMCN0490
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     5             XX2,YY1,YY2,THG1,THG2,PHG1,PHG2,ZZ1,ZZ2,LLL               TMCN0500
      DIMENSION HCAH(4),HCBH(4),HCGH(4)                                      TMCN0510
      EQUIVALENCE (HCAH(1),HCAH1),(HCBH(1),HCBH1),(HCGH(1),HCGH1)            TMCN0520
C      COMMON/EINDEX/ FOR EULER ANGLE INDEXING,MAIN,CNSTNT,DAUX,TMCNST       TMCN0530
      COMMON/EINDEX/ TWOPI,PIO2,PIO4,XINDN,XINDL,THETTL,PHITL,PSITL,         TMCN0540
     1               COSTHN,SINTHN,COSPSN,SINPSN,COSPHN,SINPHN,CTHETP,       TMCN0550
     2               STHETP,CPSTP,SPSTP,BNMTX(3,3), CNMTX(3,3),ENDEIN        TMCN0560
      COMMON /COMP4/FIDAR(2),FIDIW(2),FIDWR2(2),SPHICI(4),CPHICI(4),         TMCN0570
     1              TIHI(4),ARBRI(4), PSITEM(4),SLPFAC(4),DTSTEP,DTTEST,TMCN0580
     2       DTINT,TWOPIR,FRTEST(4),XMUI(4),FRCPMU(4),HRTERM,SLIP(4),        TMCN0590
     3              SLIPT(4),RHOS(4),EPSS(4),TERMP(4),TERMB(4),TERM(4),      TMCN0600
     4              EPSSFC,FSXFAC(4),FSYFAC(4),FSZFAC(4),FRXFAC(4),          TMCN0610
     5              FRYFAC(4),FRZFAC(4),FCXFAC(4),FCYFAC(4),FCZFAC(4),       TMCN0620
     6              SFCDTR(4),SFSDTR(4),SFRCPR(4),SSLIP(4),FCAV(4),          TMCN0630
     7              FSAV(4),FRCPAV(4),SLIPAV(4),RPSSM(4),FCSLSM(4),          TMCN0640
     8          ARTQ6(4),TQFAC(4),ARFAC1(2),ARFAC2(2),RPSFA(2),RPSFB(2),TMCN0650
     9          RPSFC(2),RPSFD(2),HRPSFA(4),HRPSFB(4),HRPSFC(4),STEPD        TMCN0660
      COMMON /COMP4/  XBRAK(16),IUVS(4),IUVB(4),IRPS,IDTCNT,ISTEP,ISTOP TMCN0670
      LOGICAL  IUVS,IUVB,IRPS                                                TMCN0680
      COMMON/INPT5/ IBTYP(2),AK1,AK2,PONE,PTWO,PZERO(2),GN(16,2),ZETAB,      TMCN0690
     1              CONE,CTWO,CTHREE,TAUA,TAUO(4),TLF(51),TTAU(51),          TMCN0700
     2              TRPME(12),TWOT(12),TCT(12),TT(101),TPC(101),TTR(101)TMCN0710
     3             ,TTS(101),BTLF,ETLF,DTLF,NTLF,BRPM,ERPM,NRPM,             TMCN0720
     4              BTT,ETT,DTT,NTT1,NTT2,NTT3,NTTS,XINPT5(9)                TMCN0730
      COMMON /INSUS/ XIF,RHOF,TSF,PHIFO,PHIFOD,DEL40,DEL40D,ISUS,            TMCN0740
     1               AKDS,AKDS1,AKDS2,AKDS3,PHIRC(50),DTHF(50),DTHR(50),TMCN0750
     2               NCAMF,NCAMR,NDTHF,NDTHR                                 TMCN0760
      COMMON /SUSCMP/ XMURO2,BXMRO2,XMTRO4,ZFO,TSFO2,RHOF2,RHFMUF,           TMCN0770
     1                RHF2MF,RF2MFI,RTF,RRTR,D3PD4,D3MD4,D43,DD3P4,          TMCN0780
     2                DD3M4,ZFD1RF,ZRD34,RFPF,RPF2M,WFMF,PHFP,PHIF2,         TMCN0790
     3                PHIFD2,RPHFD,ZFD1,ZFD2,ZRD4,TPF,SLOPE3,SLOPE4,         TMCN0800
     4                PHI3D,PHI4D,DTHF1,DTHF2,DTHR3,DTHR4,DTDD1,             TMCN0810
     5                DTDD2,DTDD3,DTDD4,FJF(4),SNPF                          TMCN0820
      DIMENSION ANAME(3)                                                     TMCN0830
      DATA ANAME(1)/4HPSIT/,ANAME(2)/4HTHET/,ANAME(3)/4HPHIT/                TMCN0840
C       * * * * FOR TEMPORARY ERROR STOP, USE THE VARIABLE ASTOP AS SHOWTMCN0850
C      ASTOP IS SOME LARGE NUMBER TO BE COMPARED TO THE ANGLES IN RADIANSTMCN0860
      DATA ASTOP/3000./                                                      TMCN0870
      IF(PHITP.GE.ASTOP .OR. THETTP.GE.ASTOP) GO TO 60                       TMCN0880
C          * * * * ** * * *                                                  TMCN0890
C           THETTL,PHITL,PSITL ARE VALUES OF THETT,PHIT,PSIT FROM PREVIOUTMCN0900
C            TIME INTERVAL, USED TO TEST NEW ANGLES     IN SUBROUTINE TMCTMCN0910
C       XINDL IS PREVIOUS VALUE OF XINDN. XINDL INITIALLY ZERO GETS BNMTXTMCN0920
C             XINDN.NE.0.0 FOR THETAO OR PHIO .NE.0.0, OR AFTER INDEXING TMCN0930
C             THAT IS  THETN OR PHIN NOW .NE. 0.0                            TMCN0940
C             USED IN MAIN PROGRAM AND IN SUBROUTINES CNSTNT,TMCNST          TMCN0950
      UQ = U*Q                                                               TMCN0960
      WP = W*P                                                               TMCN0970
      UR = U*R                                                               TMCN0980
      QR = Q*R                                                               TMCN0990
      VP = V*P                                                               TMCN1000
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```
      PR = P*R
      P2 = P*P
      Q2 = Q*Q
      R2 = R*R
      VR = V*R
      WQ = W*Q
      PQ = P*Q
      ZFD1 = ZF+DEL1
      ZRD3 = ZR+DEL3
      IF(ISUS.NE.1) GO TO 100
      D3PD4 = DEL3+DEL4
      D3MD4 = DEL3-DEL4
      D43 = -D3MD4
      DD3P4 = DEL3D+DEL4D
      DD3M4 = DEL3D-DEL4D
      ZRD34 = ZR+0.5*D3PD4
      ZRD4 = ZR+DEL4
      GO TO 200
  100 IF(ISUS.NE.2) GO TO 200
      PHIF2 = PHIF*PHIF
      PHIFD2 = PHIFD*PHIFD
      ZFD1RF = ZFD1+RHOF
      RPF2M = RHF2MF*PHIF2
      RFPF = RHOF*PHIF
      WFMF = XMUF*(DEL1D-RFPF*PHIFD)
      PHFP = PHIF-PHITP
      RPHFD = R*PHIFD
      TPF = 0.5*TF*PHIF
      GO TO 300
  200 IF(ISUS.EQ.2) GO TO 300
      ZFD2 = ZF+DEL2
      D1PD2 = DEL1+DEL2
      D1MD2 = DEL1-DEL2
      DD1P2 = DEL1D+DEL2D
      DD1M2 = DEL1D-DEL2D
      D21 = -D1MD2
      ZFD12 = ZF+0.5*D1PD2
  300 IF(ISUS.EQ.1) GO TO 400
      PHIR2 = PHIR*PHIR
      PHIRD2 = PHIRD*PHIRD
      ZRD3R = ZRD3+RHO
      ZFD3R = ZF+DEL3+RHO
      RPR = RHO*PHIR
      TIZ2 = RHMR2*PHIR2
      TG61 = XMUR*(DEL3D-RPR*PHIRD)
      PHRP = PHIR-PHITP
      TPR = 0.5*TR*PHIR
      RPHRD = R*PHIRD
  400 CONTINUE
    2 SPHTP = SIN(PHITP)
      CPHTP = COS(PHITP)
```

```
      TANTP = TAN(THETTP)
      CTHETP = COS(THETTP)
      SECTP = 1.0/CTHETP
      IF(XINDN)    7, 5, 7
    5 THETT  = THETTP
      PHIT   = PHITP
      PSIT   = PSITP + PSIN
      SINPS = SIN(PSIT)
      COSPS = COS(PSIT)
      GO TO 70
    7 IF(XINDN - XINDL)  9,11,9
C          COMPUTE BNMTX  ONCE AFTER EACH INDEXING ON THETMX
    9 XINDL = XINDN
C          IF THETAO OR PHIO .NE.0.0 COMPUTE BNMTX  ONCE AT T=TO
      COSTHN = COS(THETN)
      SINTHN = SIN(THETN)
      COSPHN = COS(PHIN)
      SINPHN = SIN(PHIN)
      COSPSN = COS(PSIN)
      SINPSN = SIN(PSIN)
      BNMTX (1,1)= COSTHN *COSPSN
      BNMTX (2,1) = COSTHN*SINPSN
      BNMTX (3,1) = -SINTHN
      BNMTX (1,2) = -COSPHN*SINPSN + SINPHN*SINTHN*COSPSN
      BNMTX (2,2) =  COSPHN*COSPSN + SINPHN*SINTHN*SINPSN
      BNMTX (3,2) =  COSTHN*SINPHN
      BNMTX (1,3) =  SINPHN*SINPSN + COSPHN*SINTHN*COSPSN
      BNMTX (2,3) = -COSPSN*SINPHN + COSPHN*SINTHN*SINPSN
      BNMTX (3,3) =  COSTHN*COSPHN
   11 STHETP = SIN(THETTP)
      SPSTP  = SIN(PSITP)
      CPSTP  = COS(PSITP)
      CNMTX (1,1) = CTHETP*CPSTP
      CNMTX (2,1) = CTHETP*SPSTP
      CNMTX (3,1) = -STHETP
      TMP1   =   SPHTP * STHETP
      TMP2   =   CPHTP * STHETP
      CNMTX (1,2) =  -CPHTP*SPSTP  + TMP1*CPSTP
      CNMTX (2,2) =    CPHTP*CPSTP  + TMP1*SPSTP
      CNMTX (3,2) =    CTHETP*SPHTP
      CNMTX (1,3) =  SPHTP*SPSTP   + TMP2*CPSTP
      CNMTX (2,3) = -CPSTP*SPHTP   + TMP2*SPSTP
      CNMTX (3,3) =  CTHETP*CPHTP
C         COMPUTE CNMTX EACH R-K STEP IF XINDN.NE.0.0
C     ITRY, INDICATOR TO ALLOW ONE ADDITIONAL REVOLUTION FOR TRIAL ANGLE
      ITRY = 0
C         IANG = 1  FOR PSIT, =2 FOR THETT,  =3 FOR PHIT  DETERMINATION
      IANG = 1
      ANGL = PSITL
      TMP3 =  BNMTX(2,1)*CNMTX(1,1) + BNMTX(2,2)*CNMTX(2,1)  +
     X        BNMTX(2,3)*CNMTX(3,1)
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      TMP4 =         BNMTX(1,1)*CNMTX(1,1) + BNMTX(1,2)*CNMTX(2,1) +      TMCN2030
     X               BNMTX(1,3)*CNMTX(3,1)                                TMCN2040
C     NOTE, TANA AND ANGA=ATAN(TANA) NOT USED WHEN DENOMINATOR TANA ZEROTMCN2050
      IF(TMP4)  18,14,18                                                  TMCN2060
   14 IF(TMP3) 15,16,17                                                   TMCN2070
   15 ANGA = - PIO2                                                       TMCN2080
      GO TO 21                                                            TMCN2090
   16 ISTOP = 4                                                           TMCN2100
      GO TO 64                                                            TMCN2110
C                                                                         TMCN2120
   17 ANGA =   PIO2                                                       TMCN2130
      GO TO 21                                                            TMCN2140
   18 TANA = TMP3/TMP4                                                    TMCN2150
C                                                                         TMCN2160
   20 ANGA = ATAN(TANA)                                                   TMCN2170
   21 NREV = ANGL/TWOPI  + SIGN(0.1 ,ANGL)                                TMCN2180
      FNREV = FLOAT(NREV)  * TWOPI                                        TMCN2190
   22 ANGTRY =  ANGA + FNREV                                              TMCN2200
      DIFFA  =  ANGTRY                                                    TMCN2210
      DIFFL =  DIFFA - ANGL                                               TMCN2220
      IF(ABS(DIFFL) - PIO4) 40,40,25                                      TMCN2230
   25 DIFFA = ANGTRY + PI                                                 TMCN2240
      DIFFL = DIFFA - ANGL                                                TMCN2250
      IF(ABS(DIFFL) - PIO4) 40,40,27                                      TMCN2260
   27 DIFFA = ANGTRY - PI                                                 TMCN2270
      DIFFL = DIFFA - ANGL                                                TMCN2280
      IF(ABS(DIFFL) - PIO4) 40,40,29                                      TMCN2290
   29 IF(ANGTRY) 30,30,31                                                 TMCN2300
   30 TWOPIA = TWOPI                                                      TMCN2310
      GO TO 32                                                            TMCN2320
   31 TWOPIA = - TWOPI                                                    TMCN2330
   32 DIFFA  =  ANGTRY + TWOPIA                                           TMCN2340
      DIFFL = DIFFA - ANGL                                                TMCN2350
      IF(ABS(DIFFL) - PIO4) 40,40,33                                      TMCN2360
   33 IF (ITRY) 36,34,36                                                  TMCN2370
   34 FNREV = FNREV + SIGN(TWOPI,ANGL)                                    TMCN2380
      ITRY = 1                                                            TMCN2390
C        ONCE ONLY, INCREASE FNREV BY ONE REVOLUTION AND TRY AGAIN        TMCN2400
      GO TO 22                                                            TMCN2410
   36 ISTOP = 5                                                           TMCN2420
      WRITE(6,1005) T,ANAME(IANG),ANGL, DIFFA ,ANGA,ANGTRY                TMCN2430
 1005 FORMAT( 7H0 TIME=,F8.3,5X,A4,11H  PREVIOUS=,1PE13.5,6H, NEW=,E13.5TMCN2440
     X,12H, AS ARCTAN=, E13.5, 16H,  CORR.FOR REV=,E13.5 ,8H   STOP5)    TMCN2450
      GO TO 64                                                            TMCN2460
C                                                                         TMCN2470
   40 ITRY = 0                                                            TMCN2480
      IF(IANG-2) 41,50,59                                                 TMCN2490
   41 IANG = 2                                                            TMCN2500
      PSIT = DIFFA                                                        TMCN2510
      SINPS  = SIN(PSIT)                                                  TMCN2520
      COSPS = COS(PSIT)                                                   TMCN2530
```

```
      ANGL = THETTL                                                     TMCN2540
      TMP5  =       -(BNMTX(3,1)*CNMTX(1,1) + BNMTX(3,2)*CNMTX(2,1) +   TMCN2550
     X                BNMTX(3,3)*CNMTX(3,1) )                           TMCN2560
      IF( ABS(SINPS) - 0.7) 42,42,43                                    TMCN2570
   42 TMPP4 = TMP4/COSPS                                                TMCN2580
      IF (TMPP4) 49,44,49                                               TMCN2590
   43 TMPP4 = TMP3/SINPS                                                TMCN2600
      IF (TMPP4) 49,44,49                                               TMCN2610
   44 IF( TMP5) 45,46,47                                                TMCN2620
   45 ANGA = - PIO2                                                     TMCN2630
      GO TO 21                                                          TMCN2640
   46 ISTOP = 6                                                         TMCN2650
      GO TO 64                                                          TMCN2660
   47 ANGA = PIO2                                                       TMCN2670
      GO TO 21                                                          TMCN2680
   49 TANA = TMP5/TMPP4                                                 TMCN2690
      GO TO 20                                                          TMCN2700
   50 IANG = 3                                                          TMCN2710
      THETT  = DIFFA                                                    TMCN2720
      ANGL  = PHITL                                                     TMCN2730
      TMP6  =  BNMTX(3,1)*CNMTX(1,2) +  BNMTX(3,2)*CNMTX(2,2)  +        TMCN2740
     X         BNMTX(3,3)*CNMTX(3,2)                                    TMCN2750
      TMP7  =  BNMTX(3,1)*CNMTX(1,3) +  BNMTX(3,2)*CNMTX(2,3)  +        TMCN2760
     X         BNMTX(3,3)*CNMTX(3,3)                                    TMCN2770
      IF(TMP7)  55,51,55                                                TMCN2780
   51 IF(TMP6)  52,53,54                                                TMCN2790
   52 ANGA = - PIO2                                                     TMCN2800
      GO TO 21                                                          TMCN2810
   53 ISTOP = 7                                                         TMCN2820
      GO TO 64                                                          TMCN2830
   54 ANGA =   PIO2                                                     TMCN2840
      GO TO 21                                                          TMCN2850
   55 TANA =  TMP6/TMP7                                                 TMCN2860
      GO TO 20                                                          TMCN2870
   59 PHIT = DIFFA                                                      TMCN2880
C       AT ST 70 HAVE NEW PSIT,THETT,PHIT                               TMCN2890
   70 CONTINUE                                                          TMCN2900
C        * * * * * * * * *                                              TMCN2910
      IF(THETT.GE.ASTOP .OR. PSIT  .GE.ASTOP) GO TO 60                  TMCN2920
      IF(PHIT .GE.ASTOP) GO TO 60                                       TMCN2930
C  70 COSTH = COS(THETT)                                                TMCN2940
C        * * * * * * * * *                                              TMCN2950
      COSTH = COS(THETT)                                                TMCN2960
      SINTH = SIN(THETT)                                                TMCN2970
C       COSPS,SINPS COMPUTED ABOVE EITHER AFTER ST 5 OR AFTER ST 41     TMCN2980
      COSPH = COS(PHIT)                                                 TMCN2990
      SINPH = SIN(PHIT)                                                 TMCN3000
    3 CONTINUE                                                          TMCN3010
      GCTH = G*COSTH                                                    TMCN3020
      GSTH = G*SINTH                                                    TMCN3030
      SFXS = 0.0                                                        TMCN3040
```

```
      ABSU = ABS(U)
      IF(ABSU.GE.1.0)SFXS=-CONE*U*ABSU-CTWO*U-CTHREE*SIGN(1.,U)
      RETURN
C        * * * * * * * * *
C      ISTOP.NE.0 CAUSES PRINTING OF OUTPUT UP TO CURRENT RUNGE-KUTTA
C        INTERVAL, MESSAGE, AND TERMINATION OF THIS RUN AT END OF THIS
C        INTERVAL IN THE MAIN PROGRAM.
C
C
   60 ISTOP = 30
C               AT 64 TEMPORARY ERROR STOP.
   64 CALL OUTPUT(2)
      CALL PLOTTP(3)
      WRITE(6,1006) T, ISTOP
 1006 FORMAT(7HO TIME=,F6.3,5X, 7H ISTOP=,I3,21H IN SUBROUTINE TMCNST)
C     CALL ABDUMP
C     SUBR ABDUMP CAUSES 'ABNORMAL END' AND DUMP ON OUR OPERATING SYSTEM
      STOP
C           IF STOP IS CODED AS HERE, DOES NOT RETURN TO MAIN PROGRAM.
C        * * * * * * * * *
C  64 WRITE(6,1006) T, ISTOP
C     RETURN
      END
```

```
      SUBROUTINE TREAD(NCARD,NCRDS,NT,NDIM,ARRAY,NERR)
C             HVOSM-VD2 VERSION
C             REVISED OCTOBER 1975   CALSPAN CORPORATION
      DIMENSION ARRAY(2),DUM(9)
      IF(NT.GT.NDIM) GO TO 90
      K = 0
      LSEQ = 0
      DO10 I=1,NCRDS
      READ(2,2000) (DUM(N),N=1,9),NSEQ,LCARD
 2000 FORMAT(9F8.0,2I4)
      IF(NCARD.NE.LCARD) GO TO 90
      IF(NSEQ.LE.LSEQ) GO TO 90
      LSEQ = NSEQ
      DO 20 N=1,9
      K = K+1
      ARRAY(K) = DUM(N)
      IF(K.GE.NT) GO TO 91
   20 CONTINUE
   10 CONTINUE
   91 RETURN
   90 NERR = 1
      RETURN
      END
```

```
      SUBROUTINE T2READ(NCARD,ND1,NI,NJ,ARRAY,NERR)
C              HVOSM-RD2 VERSION
C              HVOSM-VD2 VERSION
C              REVISED OCTOBER 1975   CALSPAN CORPORATION
      DIMENSION ARRAY(ND1,NJ),DUM(9)
      LSEQ = 0
      NICRDS = (NI-1)/9 + 1
      DO 30 J=1,NJ
      K = 0
      DO 20 I=1,NICRDS
      READ(2,2000) (DUM(N),N=1,9),NSEQ,LCARD
 2000 FORMAT(9F8.0,2I4)
      IF(NCARD.NE.LCARD) GO TO 90
      IF(NSEQ.LE.LSEQ) GO TO 90
      LSEQ = NSEQ
      DO 10 N=1,9
      K = K+1
      ARRAY(K,J) = DUM(N)
      IF(K.GE.NI) GO TO 30
   10 CONTINUE
   20 CONTINUE
   30 CONTINUE
      RETURN
   90 NERR = 1
      RETURN
      END
```

```
      SUBROUTINE UMOMNT(IS)
C               HVOSM-VD2 VERSION
C               REVISED OCTOBER 1975   CALSPAN CORPORATION
C    SUBROUTINE TO COMPUTE THE MOMENTS ACTING ON THE SPRUNG AND
C    UNSPRUNG MASSES RESULTING FROM TIRE FORCES AND SUSPENSIN FORCES.
C
      COMMON/INPT/PHIO,THETAO,PSIO,PO,QO,RO,XCOP,YCOP,ZCOP,UO,VO,WO,
     1            A,B,DEL10,DEL20,DEL30,PHIRO,DEL10D,DEL20D,DEL30D,
     2            PHIROD,TF,TR,ZF,ZR,RHO,AKRS,XMUR,
     3            XMS,XMUF,XIX,XIY,XIZ,XIXZ,CF,AKF,XLAMF,OMEGF,CFP,EPSF,
     4            RF,CR,AKR,XLAMR,OMEGR,CRP,EPSR,RR,TS,THMAX,DTCOMP,TO,
     5            T1,DTCMP1,DTPRNT,MODE,EBAR,EM,AAA,HMAX,HMIN,BET,G,
     6            HED(36),DADE(3),XIR,X1,Y1,Z1,X2,Y2,Z2,PHIC(50),DELB,
     7            DELE,DDEL,NDEL,PSIF(50),TQF(50),TQR(50),TB,TE,TINCR,
     8            NZTAB,NZ5,XBDRY(4,5),PSBDRY(4,5),YBDRY(2,5),NBX(5),
     9            NBY(5),NTBL1,NTBL2,NTBL3,ZGP(21,21,5)
      COMMON/INPT/XB(5),XE(5),XINCR(5),NX(5),YB(5),YE(5),YINCR(5),NY(5),
     1           XXZGP5(21),YYZGP5(21),AMUG(5),PSBDRO(4,5),UVWMIN,PQRMIN
      COMMON /DIMV/X1P,X2P,X3P,X4P,Y1P,Y2P,Y3P,Y4P,Z1P,Z2P,Z3P,Z4P,PHI1,
     1            PHI2,PHI3,PHI4,PSI1,PSI2,PSI3,PSI4,CAYW(4),CBYW(4),
     2            CGYW(4),ZPGI(4),THGI(4),PHGI(4),CPG(4),SPG(4),CTG(4),
     3            STG(4),CAGZ(4),CBGZ(4),CGGZ(4),D1(4),D2(4),D3(4),
     4            XLM1(4),XLM2(4),XLM3(4),AMTX(3,3),CMTX(3,4),XGPP(4),
     5            YGPP(4),ZGPP(4),DMATX(10,11),DELTA(4),CAR(4),CBR(4),
     6            CGR(4),FR(4),HI(4),FC(4),TI(4),AX(4),BX(4),CX(4),
     7            CTXG(4),UG(4),STXG(4),AY(4),BY(4),CY(4),CPYG(4),
     8            SPYG(4),VG(4),PSIIP(4),PHICI(4),CAC(4),CBC(4),CGC(4),
     9            FCXU(4),FCYU(4),FCZU(4),FS(4),CAXW(4),CBXW(4),CGXW(4)
      COMMON /DIMV/AS(4),BS(4),CS(4),CAS(4),CBS(4),CGS(4),BETP(4),
     1            BETBR(4),FSXU(4),FSYU(4),FSZU(4),FRXU(4),FRYU(4),
     2            FRZU(4),FXU(4),FYU(4),FZU(4),SI(4),F1FI(2),F1RI(2),
     3            F2FI(2),F2RI(2),CAH(4),CBH(4),CGH(4)
      DIMENSION XP(4),YP(4),ZP(4),PHII(4),PSII(4)
      EQUIVALENCE (XP(1),X1P),(YP(1),Y1P),(ZP(1),Z1P),(PHII(1),PHI1),
     1            (PSII(1),PSI1)
      COMMON /COMP/SUMM,THETN,PHIN,PSIN,PI,RAD,GAM1,GAM2,GAM3,GAM4,GAM5,
     1            GAM6,GAM7,GAM8,GAM9,THETT,PHIT,PSIT,ZRO,TRO2,
     2            TFO2,TIZ,RHO2,RHOMUR,AMUF,BMUR,ZPR,TM4,RHMR2,AO2APB,
     3            BO2APB,RFTF,TSO2,RRTS,BROMUR,XMUFO2,AXMFO2,XMTFO4,
     4            XIZR,RTR,RHMR2I,XIXP,XIZP,XIXZP,XIYZP,D1PD2,D1MD2,
     5            ZRD3,ZRD3R,ZFD3R,ZFD12,TIZ2,TG61,DD1P2,DD1M2,RPR,PHRP
     6           ,TANTP,SPHTP,CPHTP,SECTP,SFXS,SFYS,SFZS,SNPS,SNTS,
     7            SNPSS,TPR,CAY,CBY,CGY,CAX,CBX,CGX,SFYU,SFXU,SFYUF,
     8            SFYUR,SFZU,COSTH,SINTH,COSPS,SINPS,COSPH,SINPH,ANG1,
     9            ANG2,CPHI,SPHI,CPSI,SPSI,P1,P7,P3,P4,P5,P6,TX,TY,TZ
      COMMON /COMP/TRH,DISTX,DISTY,DISTD,DISTS,D21,ZETA4,ZETA4D,ZETA3,
     1            ZETA3D,SFZ1,SNPU,SNTU,HCGH1,HCGH2,HCGH3,HCGH4,TERM1,
     2            TERM2,SNPSU,SNPR,HCBH1,HCBH2,HCBH3,HCBH4,HCAH1,HCAH2,
     3            HCAH3,HCAH4,UQ,WP,UR,QR,VP,PR,P2,Q2,R2,VR,WQ,PQ,PHIR2
```

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     4              ,PHIRD2,RPHRD,GCTH,GSTH,GCTSP,GCTCP,XXX,YYY,IX,IY,XX1,
     5               XX2,YY1,YY2,THG1,THG2,PHG1,PHG2,ZZ1,ZZ2,LLL
      DIMENSION HCAH(4),HCBH(4),HCGH(4)
      EQUIVALENCE (HCAH(1),HCAH1),(HCBH(1),HCBH1),(HCGH(1),HCGH1)
      COMMON/COMP5/ TAU(4),TQD(2),TQB(4),PP(2),TLAMB(2),PC,RWDRIV,JDEND,
     1              NBTYP,ARFAC3(2),RPSFE(2),RHOSMX(3),SLIPMX(3),SLIPP,
     2              RHOMAX,RHOSAV(4),SRHOS(4),UGW(4),ABSUGW(4),VECS,
     3              DELTAE,PIO15R,COMEN5,TQE,RPME
      COMMON /INSUS/ XIF,RHOF,TSF,PHIFO,PHIFOD,DEL40,DEL40D,ISUS,
     1               AKDS,AKDS1,AKDS2,AKDS3,PHIRC(50),DTHF(50),DTHR(50),
     2               NCAMF,NCAMR,NDTHF,NDTHR
      COMMON /SUSCMP/ XMURO2,BXMRO2,XMTRO4,ZFO,TSFO2,RHCF2,RHFMUF,
     1                RHF2MF,RF2MF1,RTF,RRTR,D3PD4,D3MD4,D43,DD3P4,
     2                DD3M4,ZFD1RF,ZRD34,RFPF,RPF2M,WFMF,PHFP,PHIF2,
     3                PHIFD2,RPHFD,ZFD1,ZFD2,ZRD4,TPF,SLOPE3,SLOPE4,
     4                PHI3D,PHI4D,DTHF1,DTHF2,DTHR3,DTHR4,DTDD1,
     5                DTDD2,DTDD3,DTDD4,FJF(4),SNPF
C
      IS1 = IS+1
      GO TO (10,20,30),IS1
C
C  MOMENTS FOR SUSPENSION OPTION 0 , INDEPENDENT FRONT, SOLID AXLE REAR
C
   10 TERM1 = ZFD1+HCGH1
      TERM2 = ZFD2+HCGH2
C
C  ROLL MOMENT
C
      SNPU = -FYU(1)*TERM1 - FYU(2)*TERM2 - (FYU(3)+FYU(4))*ZRD3
     1       +SI(2)*(TFO2+DTHF2) - SI(1)*(TFO2+DTHF1)
     2       +(SI(4)-SI(3))*TSO2 + 12.0*RWDRIV*TQD(2)
C
C  PITCH MOMENT
C
      SNTU =  (SI(1)+SI(2))*A - (SI(3)+SI(4))*B
     1       +FXU(1)*TERM1 + FXU(2)*TERM2
     2       +FXU(3)*(ZRD3R+TPR+HCGH3) + FXU(4)*(ZRD3R-TPR+HCGH4)
C
C  YAW MOMENT
C
      SNPSU = FYU(1)*(A+HCAH1) + FYU(2)*(A+HCAH2)
     1       -FYU(3)*(B-HCAH3) - FYU(4)*(B-HCAH4)
     2       -FXU(1)*(TFO2+DTHF1+HCBH1) + FXU(2)*(TFO2+DTHF2-HCBH2)
     3       -FXU(3)*(TRO2-RPR+HCBH3) + FXU(4)*(TRO2+RPR-HCBH4)
C
C  REAR AXLE ROLL MOMENT
C
      SNPR =  FZU(3)*(TRO2-RPR+HCBH3) - FZU(4)*(TRO2+RPR-HCBH4)
     1       -FYU(3)*(RHO+TPR+HCGH3)  - FYU(4)*(RHO-TPR+HCGH4)
     2       +(SI(3)-SI(4))*TSO2 - 12.0*RWDRIV*TQD(2)
      RETURN
```

```
C
C   MOMENTS FOR SUSPENSION OPTION 1, INDEPENDENT FRONT AND REAR
C
   20 TERM1 = ZFD1+HCGH1
      TERM2 = ZFD2+HCGH2
      TERM3 = ZRD3+HCGH3
      TERM4 = ZRD4+HCGH4
C
C   ROLL MOMENT
C
      SNPU =  SI(2)*(TFO2+DTHF2) - SI(1)*(TFO2+DTHF1)
     1        +SI(4)*(TRO2+DTHR4) - SI(3)*(TRO2+DTHR3)
     2        -FYU(1)*TERM1 - FYU(2)*TERM2 - FYU(3)*TERM3 - FYU(4)*TERM4
C
C   PITCH MOMENT
C
      SNTU = (SI(1)+SI(2))*A - (SI(3)+SI(4))*B
     1        +FXU(1)*TERM1 + FXU(2)*TERM2 + FXU(3)*TERM3 + FXU(4)*TERM4
C
C   YAW MOMENT
C
      SNPSU = FYU(1)*(A+HCAH1) + FYU(2)*(A+HCAH2)
     1        -FYU(3)*(B-HCAH3) - FYU(4)*(B-HCAH4)
     2        -FXU(1)*(TFO2+DTHF1+HCBH1) + FXU(2)*(TFO2+DTHF2-HCBH2)
     3        -FXU(3)*(TRO2+DTHR3+HCBH3) + FXU(4)*(TRO2+DTHR4-HCBH4)
      RETURN
C
C   MOMENTS FOR SUSPENSION OPTION 2, SOLID FRONT AND REAR AXLES
C
      FWDRIV = 1.0-RWDRIV
C
C   ROLL MOMENT
C
   30 SNPU = -(FYU(1)+FYU(2))*ZFD1 - (FYU(3)+FYU(4))*ZRD3
     1        +(SI(2)-SI(1))*TSFO2  + (SI(4)-SI(3))*TSO2
     2        +12.0*RWDRIV*TQD(2) + 12.0*FWDRIV*TQD(1)
C
C   PITCH MOMENT
C
      SNTU =  (SI(1)+SI(2))*A - (SI(3)+SI(4))*B
     1        +FXU(1)*(ZFD1RF+TPF+HCGH1) + FXU(2)*(ZFD1RF-TPF+HCGH2)
     2        +FXU(3)*(ZRD3R+TPR+HCGH3)  + FXU(4)*(ZRD3R-TPR+HCGH4)
C
C   YAW MOMENT
C
      SNPSU = FYU(1)*(A+HCAH1) + FYU(2)*(A+HCAH2)
     1        -FYU(3)*(B-HCAH3) - FYU(4)*(B-HCAH4)
     2        -FXU(1)*(TFO2-RFPF+HCBH1) + FXU(2)*(TFO2+RFPF-HCBH2)
     3        -FXU(3)*(TRO2-RPR+HCBH3)  + FXU(4)*(TRO2+RPR-HCBH4)
C
C   FRONT AXLE ROLL MOMENT
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```
C
      SNPF =  FZU(1)*(TFO2-RFPF+HCBH1) - FZU(2)*(TFO2+RFPF-HCBH2)
     1        -FYU(1)*(RHOF+TPF+HCGH1)  - FYU(2)*(RHOF-TPF+HCGH2)
     2        +(SI(1)-SI(2))*TSFO2 - 12.0*FWDRIV*TQD(1)
C
C  REAR AXLE ROLL MOMENT
C
      SNPR =  FZU(3)*(TRO2-RPR+HCBH3) - FZU(4)*(TRO2+RPR-HCBH4)
     1        -FYU(3)*(RHO+TPR+HCGH3)  - FYU(4)*(RHO-TPR+HCGH4)
     2        +(SI(3)-SI(4))*TSO2 - 12.0*RWDRIV*TQD(2)
      RETURN
      END
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      SUBROUTINE VGORNT                                                 VGOR0010
C              HVOSM-VD2 VERSION                                        VGOR0020
C              REVISED OCTOBER 1975  CALSPAN CORPORATION                VGOR0030
      COMMON/INPT/PHIO,THETAO,PSIO,PO,QO,RO,XCOP,YCOP,ZCOP,UO,VO,WO,    VGOR0040
     1           A,B,DEL10,DEL20,DEL30,PHIRO,DEL10D,DEL20D,DEL30D,      VGOR0050
     2           PHIROD,TF,TR,ZF,ZR,RHO,AKRS,XMUR,                      VGOR0060
     3           XMS,XMUF,XIX,XIY,XIZ,XIXZ,CF,AKF,XLAMF,OMEGF,CFP,EPSF,VGOR0070
     4           RF,CR,AKR,XLAMR,OMEGR,CRP,EPSR,RR,TS,THMAX,DTCOMP,TO,  VGOR0080
     5           T1,DTCMP1,DTPRNT,MODE,EBAR,EM,AAA,HMAX,HMIN,BET,G,     VGOR0090
     6           HED(36),DADE(3),XIR,X1,Y1,Z1,X2,Y2,Z2,PHIC(50),DELB,   VGOR0100
     7           DELE,DDEL,NDEL,PSIF(50),TQF(50),TQR(50),TB,TE,TINCR,   VGOR0110
     8           NZTAB,NZ5,XBDRY(4,5),PSBDRY(4,5),YBDRY(2,5),NBX(5),    VGOR0120
     9           NBY(5),NTBL1,NTBL2,NTBL3,ZGP(21,21,5)                  VGOR0130
      COMMON/INPT/XB(5),XE(5),XINCR(5),NX(5),YB(5),YE(5),YINCR(5),NY(5),VGOR0140
     1        XXZGP5(21),YYZGP5(21),AMUG(5),PSBDRO(4,5),UVWMIN,PQRMIN  VGOR0150
      COMMON/INPT1/YC1P,YC2P,ZC2P,DELTC,PHIC1,PHIC2,AMUC,XIPS,          VGOR0160
     1             CPSP,OMGPS,AKPS,EPSPS,XPS,RWHJB,RWHJE,DRWHJ,INDCRB,  VGOR0170
     2             PSIFIO,PSIFDO                                        VGOR0180
      DIMENSION YCIP(2)                                                 VGOR0190
      EQUIVALENCE (YCIP(1),YC1P)                                        VGOR0200
      COMMON /INTG/NEQ,T,DT,VAR(50),DER(50)                             VGOR0210
      EQUIVALENCE (U,VAR(1)),(V,VAR(2)),(W,VAR(3)),(P,VAR(4)),(Q,VAR(5))VGOR0220
     1        ,(R,VAR(6)),(DEL1,VAR(7)),(DEL1D,VAR(8)),(DEL2,VAR(9)),VGOR0230
     2           (DEL2D,VAR(10)),(DEL3,VAR(11)),(DEL3D,VAR(12)),        VGOR0240
     3           (PHIR,VAR(13)),(PHIRD,VAR(14)),(THETTP,VAR(15)),       VGOR0250
     4           (PHITP,VAR(16)),(PSITP,VAR(17)),(XCP,VAR(18)),         VGOR0260
     5           (YCP,VAR(19)),(ZCP,VAR(20)),(PSIFI,VAR(21)),           VGOR0270
     6           (PSIFID,VAR(22))                                       VGOR0280
      EQUIVALENCE (DU,DER(1)),(DV,DER(2)),(DW,DER(3)),(DP,DER(4)),      VGOR0290
     1           (DQ,DER(5)),(DR,DER(6)),(DDEL1,DER(7)),(DDEL1D,DER(8))VGOR0300
     2        ,(DDEL2,DER(9)),(DDEL2D,DER(10)),(DDEL3,DER(11)),         VGOR0310
     3           (DDEL3D,DER(12)),(DPHIR,DER(13)),(DPHIRD,DER(14)),     VGOR0320
     4           (DTHTTP,DER(15)),(DPHITP,DER(16)),(DPSITP,DER(17)),    VGOR0330
     5           (DXCP,DER(18)),(DYCP,DER(19)),(DZCP,DER(20)),          VGOR0340
     6           (DPSIFI,DER(21)),(DDPSFI,DER(22))                      VGOR0350
      EQUIVALENCE (VAR(9),PHIF),(VAR(10),PHIFD),(DER(9),DPHIF),         VGOR0360
     1           (DER(10),DPHIFD)                                       VGOR0370
      EQUIVALENCE (VAR(13),DEL4),(VAR(14),DEL4D),(DER(13),DDEL4),       VGOR0380
     1           (DER(14),DDEL4D)                                       VGOR0390
      COMMON /DIMV/X1P,X2P,X3P,X4P,Y1P,Y2P,Y3P,Y4P,Z1P,Z2P,Z3P,Z4P,PHI1,VGOR0400
     1             PHI2,PHI3,PHI4,PSI1,PSI2,PSI3,PSI4,CAYW(4),CBYW(4),  VGOR0410
     2             CGYW(4),ZPGI(4),THGI(4),PHGI(4),CPG(4),SPG(4),CTG(4),VGOR0420
     3             STG(4),CAGZ(4),CBGZ(4),CGGZ(4),D1(4),D2(4),D3(4),    VGOR0430
     4             XLM1(4),XLM2(4),XLM3(4),AMTX(3,3),CMTX(3,4),XGPP(4), VGOR0440
     5             YGPP(4),ZGPP(4),DMATX(10,11),DELTA(4),CAR(4),CBR(4), VGOR0450
     6             CGR(4),FR(4),HI(4),FC(4),TI(4),AX(4),BX(4),CX(4),    VGOR0460
     7             CTXG(4),UG(4),STXG(4),AY(4),BY(4),CY(4),CPYG(4),     VGOR0470
     8             SPYG(4),VG(4),PSIIP(4),PHICI(4),CAC(4),CBC(4),CGC(4),VGOR0480
     9             FCXU(4),FCYU(4),FCZU(4),FS(4),CAXW(4),CBXW(4),CGXW(4)VGOR0490
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      COMMON /DIMV/AS(4),BS(4),CS(4),CAS(4),CBS(4),CGS(4),BETP(4),
     1             BETBR(4),FSXU(4),FSYU(4),FSZU(4),FRXU(4),FRYU(4),
     2             FRZU(4),FXU(4),FYU(4),FZU(4),SI(4),F1FI(2),F1RI(2),
     3             F2FI(2),F2RI(2),CAH(4),CBH(4),CGH(4)
      DIMENSION XP(4),YP(4),ZP(4),PHII(4),PSII(4)
      EQUIVALENCE (XP(1),X1P),(YP(1),Y1P),(ZP(1),Z1P),(PHII(1),PHI1),
     1            (PSII(1),PSI1)
      COMMON /COMP/SUMM,THETN,PHIN,PSIN,PI,RAD,GAM1,GAM2,GAM3,GAM4,GAM5,
     1            GAM6,GAM7,GAM8,GAM9,THETT,PHIT,PSIT,ZRO,TRO2,
     2             TFO2,TIZ,RHO2,RHOMUR,AMUF,BMUR,ZPR,TM4,RHMR2,AO2APB,
     3             BO2APB,RFTF,TSO2,RRTS,BROMUR,XMUFO2,AXMFO2,XMTFO4,
     4             XIZR,RTR,RHMR2I,XIXP,XIZP,XIXZP,XIYZP,D1PD2,D1MD2,
     5             ZRD3,ZRD3R,ZFD3R,ZFD12,TIZ2,TG61,DD1P2,DD1M2,RPR,PHRP
     6            ,TANTP,SPHTP,CPHTP,SECTP,SFXS,SFYS,SFZS,SNPS,SNTS,
     7             SNPSS,TPR,CAY,CBY,CGY,CAX,CBX,CGX,SFYU,SFXU,SFYUF,
     8             SFYUR,SFZU,COSTH,SINTH,COSPS,SINPS,COSPH,SINPH,ANG1,
     9             ANG2,CPHI,SPHI,CPSI,SPSI,P1,P7,P3,P4,P5,P6,TX,TY,TZ
      COMMON /COMP/TRH,DISTX,DISTY,DISTD,DISTS,D21,ZETA4,ZETA4D,ZETA3,
     1             ZETA3D,SFZ1,SNPU,SNTU,HCGH1,HCGH2,HCGH3,HCGH4,TERM1,
     2             TERM2,SNPSU,SNPR,HCBH1,HCBH2,HCBH3,HCBH4,HCAH1,HCAH2,
     3             HCAH3,HCAH4,UQ,WP,UR,QR,VP,PR,P2,Q2,R2,VR,WQ,PQ,PHIR2
     4            ,PHIRD2,RPHRD,GCTH,GSTH,GCTSP,GCTCP,XXX,YYY,IX,IY,XX1,
     5             XX2,YY1,YY2,THG1,THG2,PHG1,PHG2,ZZ1,ZZ2,LLL
      DIMENSION HCAH(4),HCBH(4),HCGH(4)
      EQUIVALENCE (HCAH(1),HCAH1),(HCBH(1),HCBH1),(HCGH(1),HCGH1)
      COMMON /COMPN/ FRSP(4),FRCP(4),ICBHIT,JCBHIT,
     1               DPSINT,TANPC1,TANPC2,PHIC1R,PHIC2R,AMUCMP,PHI1D,
     2               PHI2D,LCB1(4),LCB2(4),IHIT,AJMTX(3,3),BMTX(3,3),
     3               SFRX(4),SFRY(4),SFRZ(4),T1PSI,T2PSI,XMUGI(4)
      LOGICAL LCB1,LCB2
      COMMON/ADTNL/ U1,U2,U3,U4,V1,V2,V3,V4,W1,W2,W3,W4,
     1              XIYP,SPHIC,CPHIC,APTCH1,APTCH2,APTCH3,APTCH4,
     2              SLOPE1,SLOPE2,XTRA(300)
      DIMENSION UI(4),VI(4),WI(4)
      EQUIVALENCE (UI(1),U1),(VI(1),V1),(WI(1),W1)
      DIMENSION APITCH(4)
      EQUIVALENCE (APITCH(1),APTCH1)
      COMMON /TIRIN/ AKT(4),SIGT(4),XLAMT(4),A0(4),A1(4),A2(4),A3(4),
     1               A4(4),OMEGT(4),AMU(4),RW(4),FJP(35,4),A234(4),
     2               A12(4),OMT2A2(4),OMT2M1(4),A23(4),ITIR(4)
      COMMON /INSUS/ XIF,RHOF,TSF,PHIFO,PHIFOD,DEL40,DEL40D,ISUS,
     1               AKDS,AKDS1,AKDS2,AKDS3,PHIRC(50),DTHF(50),DTHR(50),
     2               NCAMF,NCAMR,NDTHF,NDTHR
      COMMON /SUSCMP/ XMURO2,BXMRO2,XMTRO4,ZFO,TSFO2,RHOF2,RHFMUF,
     1                RHF2MF,RF2MFI,RTF,RRTR,D3PD4,D3MD4,D43,DD3P4,
     2                DD3M4,ZFD1RF,ZRD34,RFPF,RPF2M,WFMF,PHFP,PHIF2,
     3                PHIFD2,RPHFD,ZFD1,ZFD2,ZRD4,TPF,SLOPE3,SLOPE4,
     4                PHI3D,PHI4D,DTHF1,DTHF2,DTHR3,DTHR4,DTDD1,
     5                DTDD2,DTDD3,DTDD4,FJF(4),SNPF
      COMMON/NEWCRB/ YC3P,YC4P,YC5P,YC6P,YCLP,
     1               ZC3P,ZC4P,ZC5P,ZC6P,ZCLP,
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     2             PHIC3,PHIC4,PHIC5,PHIC6,NCRBSL,
     3             TANPC3,TANPC4,TANPC5,TANPC6,TANPCL,
     4             PHIC3R,PHIC4R,PHIC5R,PHIC6R,PHICLR,
     5             YCMP(6),ZCMP(6),PHICM(6)
      COMMON /RUFNES/ DELG,DGMAX,NEND,IRUF
    1 DO 17  I=1,4
      XCPHI = COS(PHII(I))
      XSPHI = SIN(PHII(I))
      XCPSI = COS(PSII(I))
      XSPSI = SIN(PSII(I))
      TMP4 =   XCPHI * XCPSI
      TMP3 =   XSPHI * XCPSI
    2 CAYW(I) =-AMTX(1,1)*XSPSI+ AMTX(1,2)*TMP4 + AMTX(1,3)*TMP3
      CBYW(I) =-AMTX(2,1)*XSPSI+ AMTX(2,2)*TMP4 + AMTX(2,3)*TMP3
      CGYW(I) =-AMTX(3,1)*XSPSI+ AMTX(3,2)*TMP4 + AMTX(3,3)*TMP3
      IF(INDCRB.LE.0) GO TO 3
      LCB1(I) = RW(I).GT.YC1P-YP(I)
      LCB2(I) = RW(I).LE.YP(I)-YCLP
      IF(ICBHIT.EQ.0) GO TO 3
      PHGI(I) = 0.0
      THGI(I) = 0.0
      ZPGI(I) = 0.0
      SPG(I) = 0.0
      CPG(I) = 1.0
      STG(I) = 0.0
      CTG(I) = 1.0
      IF(.NOT.LCB2(I)) GO TO 4
      ZPGI(I) = ZCLP+(YP(I)-YCLP)*TANPCL
      PHGI(I) = PHICLR
      SPG(I) = SIN(PHGI(I))
      CPG(I) = COS(PHGI(I))
      GO TO 30
C         INTRP5 LOOKS UP THGI, PHGI, ZPGI, AND XMUGI FOR EACH WHEEL.
    3 IF(IRUF.EQ.0) GO TO 31
      IF(XP(I)+RW(I).LT.0.0.OR.XP(I)-RW(I).GT.DGMAX) GO TO 31
      CALL RUFFRC(I,ZGP)
      XMUGI(I) = AMU(I)
      GO TO 33
   31 CALL INTRP5(I)
   32 CPG(I) = COS(PHGI(I))
      SPG(I) = SIN(PHGI(I))
      CTG(I) = COS(THGI(I))
      STG(I) = SIN(THGI(I))
   30 CAGZ(I) = CPG(I)*STG(I)
      CBGZ(I) = -SPG(I)
      CGGZ(I) = CTG(I)*CPG(I)
      P1 = CBYW(I)*CGGZ(I)
      P7 = CBGZ(I)*CGYW(I)
      P3 = CGYW(I)*CAGZ(I)
      P4 = CGGZ(I)*CAYW(I)
      P5 = CAYW(I)*CBGZ(I)
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      P6 = CAGZ(I)*CBYW(I)
      D1(I) = P1-P7
      D2(I) = P3-P4
      D3(I) = P5-P6
      CALL GCP(I)
C           XMUGI(I) IS SET IN INTRP5
C           IF ICBHIT.NE.0 AND LCB1(I) AND LCB2(I) BOTH  FALSE,  XMUGI(I)
C           NOT SET IN THIS INTERVAL.  RETAINS LAST VALUE, SHOULD BE FOR
C           FLAT TERRAIN. (RADIAL SPRING TIRE MODE IN CRBIMP REQUIRES
C           FLAT TERRAIN PREVIOUS TO CURB HIT)
      GO TO 5
    4 IF(.NOT.LCB1(I))GO TO 30
      CALL CRBIMP(I)
      XMUGI(I) = AMUC*AMU(I)
   33 CAGZ(I) = CPG(I)*STG(I)
      CBGZ(I) = -SPG(I)
      CGGZ(I) = CTG(I)*CPG(I)
      P1 = CBYW(I)*CGGZ(I)
      P7 = CBGZ(I)*CGYW(I)
      P3 = CGYW(I)*CAGZ(I)
      P4 = CGGZ(I)*CAYW(I)
      P5 = CAYW(I)*CBGZ(I)
      P6 = CAGZ(I)*CBYW(I)
      D1(I) = P1-P7
      D2(I) = P3-P4
      D3(I) = P5-P6
    5 CAH(I) = AMTX(1,1)*CAR(I)+AMTX(2,1)*CBR(I)+AMTX(3,1)*CGR(I)
      CBH(I) = AMTX(1,2)*CAR(I)+AMTX(2,2)*CBR(I)+AMTX(3,2)*CGR(I)
      CGH(I) = AMTX(1,3)*CAR(I)+AMTX(2,3)*CBR(I)+AMTX(3,3)*CGR(I)
      HCAH(I) = HI(I)*CAH(I)
      HCBH(I) = HI(I)*CBH(I)
      HCGH(I) = HI(I)*CGH(I)
   17 CONTINUE
C
      IF(ISUS.NE.0) GO TO 90
      V1 = V+A*R-ZFD1*P-HCGH1*(P+PHI1D)+DTDD1*DEL1D
      V2 = V+A*R-ZFD2*P-HCGH2*(P+PHI2D)-DTDD2*DEL2D
      V3 = V-B*R-ZRD3*P-(RHO+TPR+HCGH3)*(P+PHIRD)
      V4 = V-B*R-ZRD3*P-(RHO-TPR+HCGH4)*(P+PHIRD)
      W1 = W-A*Q+(TFO2+DTHF1)*P+DEL1D+HCBH1*(P+PHI1D)
      W2 = W-A*Q-(TFO2+DTHF2)*P+DEL2D+HCBH2*(P+PHI2D)
      W3 = W+B*Q+DEL3D-(RPR-TRO2-HCBH3)*(P+PHIRD)
      W4 = W+B*Q+DEL3D-(RPR+TRO2-HCBH4)*(P+PHIRD)
      GO TO 95
   90 IF(ISUS.EQ.2) GO TO 91
      V1 = V+A*R-ZFD1*P-HCGH1*(P+PHI1D)+DTDD1*DEL1D
      V2 = V+A*R-ZFD2*P-HCGH2*(P+PHI2D)-DTDD2*DEL2D
      V3 = V-B*R-ZRD3*P-HCGH3*(P+PHI3D)+DTDD3*DEL3D
      V4 = V-B*R-ZRD4*P-HCGH4*(P+PHI4D)-DTDD4*DEL4D
      W1 = W-A*Q+(TFO2+DTHF1)*P+DEL1D+HCBH1*(P+PHI1D)
      W2 = W-A*Q-(TFO2+DTHF2)*P+DEL2D+HCBH2*(P+PHI2D)
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      W3 = W+B*Q+(TRO2+DTHR3)*P+DEL3D+HCBH3*(P+PHI3D)
      W4 = W+B*Q-(TRO2+DTHR4)*P+DEL4D+HCBH4*(P+PHI4D)
      GO TO 95
   91 V1 = V+A*R-ZFD1*P-(RHOF+TPF+HCGH1)*(P+PHIFD)
      V2 = V+A*R-ZFD1*P-(RHOF-TPF+HCGH2)*(P+PHIFD)
      V3 = V-B*R-ZRD3*P-(RHO+TPR+HCGH3)*(P+PHIRD)
      V4 = V-B*R-ZRD3*P-(RHO-TPR+HCGH4)*(P+PHIRD)
      W1 = W-A*Q+DEL1D-(RFPF-TFO2-HCBH1)*(P+PHIFD)
      W2 = W-A*Q+DEL1D-(RFPF+TFO2-HCBH2)*(P+PHIFD)
      W3 = W+B*Q+DEL3D-(RPR-TRO2-HCBH3)*(P+PHIRD)
      W4 = W+B*Q+DEL3D-(RPR+TRO2-HCBH4)*(P+PHIRD)
C
   95 DO 170 I=1,4
   10 AX(I) = CBY*CGGZ(I)-CGY*CBGZ(I)
      BX(I) = CGY*CAGZ(I)-CAY*CGGZ(I)
      CX(I) = CAY*CBGZ(I)-CBY*CAGZ(I)
      DISTX = SQRT(AX(I)**2+BX(I)**2+CX(I)**2)
      CTXG(I) = (CAX*AX(I)+CBX*BX(I)+CGX*CX(I))/DISTX
      CTXG(I) = SIGN(AMIN1(ABS(CTXG(I)),1.0),CTXG(I))
      STXG(I) = SIGN(SQRT(1.0-CTXG(I)**2),CGX*DISTX-CX(I))
      UG(I) = UI(I)*CTXG(I)-WI(I)*STXG(I)
   11 AY(I) = CGX*CBGZ(I)-CBX*CGGZ(I)
      BY(I) = CAX*CGGZ(I)-CGX*CAGZ(I)
      CY(I) = CBX*CAGZ(I)-CAX*CBGZ(I)
      DISTY = SQRT(AY(I)**2+BY(I)**2+CY(I)**2)
   12 CPYG(I) = (CAY*AY(I)+CBY*BY(I)+CGY*CY(I))/DISTY
      CPYG(I) = SIGN(AMIN1(ABS(CPYG(I)),1.0),CPYG(I))
      SPYG(I) = SIGN(SQRT(1.0-CPYG(I)**2),CGY*DISTY-CY(I))
      VG(I) = VI(I)*CPYG(I)-WI(I)*SPYG(I)
      DISTD = SQRT(D1(I)**2+D2(I)**2+D3(I)**2)
   13 CAZW = - AMTX(1,2)*XSPHI + AMTX(1,3)*XCPHI
      CBZW = - AMTX(2,2)*XSPHI + AMTX(2,3)*XCPHI
      CGZW = - AMTX(3,2)*XSPHI + AMTX(3,3)*XCPHI
      PSIIP(I) = PSII(I)*(CAGZ(I)*CAZW+CBGZ(I)*CBZW+CGGZ(I)*CGZW)
   14 CAC(I) = D1(I)/DISTD
      CBC(I) = D2(I)/DISTD
      CGC(I) = D3(I)/DISTD
   15 AS(I) = CGC(I)*CBGZ(I)-CBC(I)*CGGZ(I)
      BS(I) = CAC(I)*CGGZ(I)-CGC(I)*CAGZ(I)
      CS(I) = CBC(I)*CAGZ(I)-CAC(I)*CBGZ(I)
      DISTS = SQRT(AS(I)**2+BS(I)**2+CS(I)**2)
      CAS(I) = AS(I)/DISTS
      CBS(I) = BS(I)/DISTS
      CGS(I) = CS(I)/DISTS
C
C  16 CALL TIRFRC(I)
C
  170 CONTINUE
      RETURN
      END
```

```
      SUBROUTINE VPOS                                                   VPOS0010
C          HVOSM-VD2 VERSION                                            VPOS0020
C             REVISED OCTOBER 1975  CALSPAN CORPORATION                 VPOS0030
      COMMON/INPT/PHIO,THETAO,PSIO,PO,QO,RO,XCOP,YCOP,ZCOP,UO,VO,WO,    VPOS0040
     1           A,B,DEL10,DEL20,DEL30,PHIRO,DEL10D,DEL20D,DEL30D,      VPOS0050
     2           PHIROD,TF,TR,ZF,ZR,RHO,AKRS,XMUR,                      VPOS0060
     3           XMS,XMUF,XIX,XIY,XIZ,XIXZ,CF,AKF,XLAMF,OMEGF,CFP,EPSF,VPOS0070
     4           RF,CR,AKR,XLAMR,OMEGR,CRP,EPSR,RR,TS,THMAX,DTCOMP,TO,  VPOS0080
     5           T1,DTCMP1,DTPRNT,MODE,EBAR,EM,AAA,HMAX,HMIN,BET,G,     VPOS0090
     6           HED(36),DADE(3),XIR,X1,Y1,Z1,X2,Y2,Z2,PHIC(50),DELB,   VPOS0100
     7           DELE,DDEL,NDEL,PSIF(50),TQF(50),TQR(50),TB,TE,TINCR,   VPOS0110
     8           NZTAB,NZ5,XBDRY(4,5),PSBDRY(4,5),YBDRY(2,5),NBX(5),    VPOS0120
     9           NBY(5),NTBL1,NTBL2,NTBL3,ZGP(21,21,5)                  VPOS0130
      COMMON/INPT/XB(5),XE(5),XINCR(5),NX(5),YB(5),YE(5),YINCR(5),NY(5),VPOS0140
     1          XXZGP5(21),YYZGP5(21),AMUG(5),PSBDRO(4,5),UVWMIN,PQRMIN VPOS0150
      COMMON/INPT1/YC1P,YC2P,ZC2P,DELTC,PHIC1,PHIC2,AMUC,XIPS,          VPOS0160
     1            CPSP,OMGPS,AKPS,EPSPS,XPS,RWHJB,RWHJE,DRWHJ,INDCRB,   VPOS0170
     2            PSIFIO,PSIFDO                                         VPOS0180
      DIMENSION YCIP(2)                                                 VPOS0190
      EQUIVALENCE (YCIP(1),YC1P)                                        VPOS0200
      COMMON /INTG/NEQ,T,DT,VAR(50),DER(50)                             VPOS0210
      EQUIVALENCE (U,VAR(1)),(V,VAR(2)),(W,VAR(3)),(P,VAR(4)),(Q,VAR(5))VPOS0220
     1          ,(R,VAR(6)),(DEL1,VAR(7)),(DEL1D,VAR(8)),(DEL2,VAR(9)),VPOS0230
     2           (DEL2D,VAR(10)),(DEL3,VAR(11)),(DEL3D,VAR(12)),        VPOS0240
     3           (PHIR,VAR(13)),(PHIRD,VAR(14)),(THETTP,VAR(15)),       VPOS0250
     4           (PHITP,VAR(16)),(PSITP,VAR(17)),(XCP,VAR(18)),         VPOS0260
     5           (YCP,VAR(19)),(ZCP,VAR(20)),(PSIFI,VAR(21)),           VPOS0270
     6           (PSIFID,VAR(22))                                       VPOS0280
      EQUIVALENCE (DU,DER(1)),(DV,DER(2)),(DW,DER(3)),(DP,DER(4)),      VPOS0290
     1           (DQ,DER(5)),(DR,DER(6)),(DDEL1,DER(7)),(DDEL1D,DER(8))VPOS0300
     2          ,(DDEL2,DER(9)),(DDEL2D,DER(10)),(DDEL3,DER(11)),       VPOS0310
     3           (DDEL3D,DER(12)),(DPHIR,DER(13)),(DPHIRD,DER(14)),     VPOS0320
     4           (DTHTTP,DER(15)),(DPHITP,DER(16)),(DPSITP,DER(17)),    VPOS0330
     5           (DXCP,DER(18)),(DYCP,DER(19)),(DZCP,DER(20)),          VPOS0340
     6           (DPSIFI,DER(21)),(DDPSFI,DER(22))                      VPOS0350
      EQUIVALENCE (VAR(9),PHIF),(VAR(10),PHIFD),(DER(9),DPHIF),         VPOS0360
     1           (DER(10),DPHIFD)                                       VPOS0370
      EQUIVALENCE (VAR(13),DEL4),(VAR(14),DEL4D),(DER(13),DDEL4),       VPOS0380
     1           (DER(14),DDEL4D)                                       VPOS0390
      COMMON /DIMV/X1P,X2P,X3P,X4P,Y1P,Y2P,Y3P,Y4P,Z1P,Z2P,Z3P,Z4P,PHI1,VPOS0400
     1            PHI2,PHI3,PHI4,PSI1,PSI2,PSI3,PSI4,CAYW(4),CBYW(4),   VPOS0410
     2            CGYW(4),ZPGI(4),THGI(4),PHGI(4),CPG(4),SPG(4),CTG(4),VPOS0420
     3            STG(4),CAGZ(4),CBGZ(4),CGGZ(4),D1(4),D2(4),D3(4),     VPOS0430
     4            XLM1(4),XLM2(4),XLM3(4),AMTX(3,3),CMTX(3,4),XGPP(4),  VPOS0440
     5            YGPP(4),ZGPP(4),DMATX(10,11),DELTA(4),CAR(4),CBR(4),  VPOS0450
     6            CGR(4),FR(4),HI(4),FC(4),TI(4),AX(4),BX(4),CX(4),     VPOS0460
     7            CTXG(4),UG(4),STXG(4),AY(4),BY(4),CY(4),CPYG(4),      VPOS0470
     8            SPYG(4),VG(4),PSIIP(4),PHICI(4),CAC(4),CBC(4),CGC(4),VPOS0480
     9            FCXU(4),FCYU(4),FCZU(4),FS(4),CAXW(4),CBXW(4),CGXW(4)VPOS0490
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      COMMON /DIMV/AS(4),BS(4),CS(4),CAS(4),CBS(4),CGS(4),BETP(4),
     1              BETBR(4),FSXU(4),FSYU(4),FSZU(4),FRXU(4),FRYU(4),
     2              FRZU(4),FXU(4),FYU(4),FZU(4),SI(4),F1FI(2),F1RI(2),
     3              F2FI(2),F2RI(2),CAH(4),CBH(4),CGH(4)
      DIMENSION XP(4),YP(4),ZP(4),PHII(4),PSII(4)
      EQUIVALENCE (XP(1),X1P),(YP(1),Y1P),(ZP(1),Z1P),(PHII(1),PHI1),
     1            (PSII(1),PSI1)
      COMMON /COMP/SUMM,THETN,PHIN,PSIN,PI,RAD,GAM1,GAM2,GAM3,GAM4,GAM5,
     1             GAM6,GAM7,GAM8,GAM9,THETT,PHIT,PSIT,ZRO,TRO2,
     2              TFO2,TIZ,RHO2,RHOMUR,AMUF,BMUR,ZPR,TM4,RHMR2,AO2APB,
     3              BO2APB,RFTF,TSO2,RRTS,BROMUR,XMUFO2,AXMFO2,XMTFO4,
     4              XIZR,RTR,RHMR2I,XIXP,XIZP,XIXZP,XIYZP,D1PD2,D1MD2,
     5              ZRD3,ZRD3R,ZFD3R,ZFD12,TIZ2,TG61,DD1P2,DD1M2,RPR,PHRP
     6             ,TANTP,SPHTP,CPHTP,SECTP,SFXS,SFYS,SFZS,SNPS,SNTS,
     7              SNPSS,TPR,CAY,CBY,CGY,CAX,CBX,CGX,SFYU,SFXU,SFYUF,
     8              SFYUR,SFZU,COSTH,SINTH,COSPS,SINPS,COSPH,SINPH,ANG1,
     9              ANG2,CPHI,SPHI,CPSI,SPSI,P1,P7,P3,P4,P5,P6,TX,TY,TZ
      COMMON /COMP/TRH,DISTX,DISTY,DISTD,DISTS,D21,ZETA4,ZETA4D,ZETA3,
     1              ZETA3D,SFZ1,SNPU,SNTU,HCGH1,HCGH2,HCGH3,HCGH4,TERM1,
     2              TERM2,SNPSU,SNPR,HCBH1,HCBH2,HCBH3,HCBH4,HCAH1,HCAH2,
     3              HCAH3,HCAH4,UQ,WP,UR,QR,VP,PR,P2,Q2,R2,VR,WQ,PQ,PHIR2
     4             ,PHIRD2,RPHRD,GCTH,GSTH,GCTSP,GCTCP,XXX,YYY,IX,IY,XX1,
     5              XX2,YY1,YY2,THG1,THG2,PHG1,PHG2,ZZ1,ZZ2,LLL
      DIMENSION HCAH(4),HCBH(4),HCGH(4)
      EQUIVALENCE (HCAH(1),HCAH1),(HCBH(1),HCBH1),(HCGH(1),HCGH1)
      COMMON /COMPN/ FRSP(4),FRCP(4),ICBHIT,JCBHIT,
     1                DPSINT,TANPC1,TANPC2,PHIC1R,PHIC2R,AMUCMP,PHI1D,
     2                PHI2D,LCB1(4),LCB2(4),IHIT,AJMTX(3,3),BMTX(3,3),
     3                SFRX(4),SFRY(4),SFRZ(4),T1PSI,T2PSI,XMUGI(4)
      LOGICAL LCB1,LCB2
      COMMON/ADTNL/ U1,U2,U3,U4,V1,V2,V3,V4,W1,W2,W3,W4,
     1               XIYP,SPHIC,CPHIC,APTCH1,APTCH2,APTCH3,APTCH4,
     2               SLOPE1,SLOPE2,XTRA(300)
      DIMENSION UI(4),VI(4),WI(4)
      EQUIVALENCE (UI(1),U1),(VI(1),V1),(WI(1),W1)
      DIMENSION APITCH(4)
      EQUIVALENCE (APITCH(1),APTCH1)
      COMMON /INSUS/ XIF,RHOF,TSF,PHIFO,PHIFOD,DEL40,DEL40D,ISUS,
     1                AKDS,AKDS1,AKDS2,AKDS3,PHIRC(50),DTHF(50),DTHR(50),
     2                NCAMF,NCAMR,NDTHF,NDTHR
      COMMON /SUSCMP/ XMURO2,BXMRO2,XMTRO4,ZFO,TSFO2,RHOF2,RHFMUF,
     1                 RHF2MF,RF2MFI,RTF,RRTR,D3PD4,D3MD4,D43,DD3P4,
     2                 DD3M4,ZFD1RF,ZRD34,RFPF,RPF2M,WFMF,PHFP,PHIF2,
     3                 PHIFD2,RPHFD,ZFD1,ZFD2,ZRD4,TPF,SLOPE3,SLOPE4,
     4                 PH13D,PHI4D,DTHF1,DTHF2,DTHR3,DTHR4,DTDD1,
     5                 DTDD2,DTDD3,DTDD4,FJF(4),SNPF
C
      IS1 = ISUS+1
C
C   LONGITUDINAL WHEEL CENTER VELOCITIES
C
```

```
      GO TO (10,11,12),IS1
C
C  SUSPENSION OPTION 0, INDEPENDENT FRONT AND SOLID AXLE REAR
C
   10 IF(NDTHF.EQ.0) GO TO 101
      CALL INTRPC(DTHF,DELB,DELE,DDEL,DEL1,DTHF1,DTDD1)
      CALL INTRPC(DTHF,DELB,DELE,DDEL,DEL2,DTHF2,DTDD2)
  101 U1 = U-(TF02+DTHF1)*R+ZFD1*Q
      U2 = U+(TF02+DTHF2)*R+ZFD2*Q
      U3 = U-(TR02-RPR)*R+(ZRD3R+TPR)*Q
      U4 = U+(TR02+RPR)*R+(ZRD3R-TPR)*Q
      GO TO 13
C
C  SUSPENSION OPTION 1, INDEPENDENT FRONT AND REAR
C
   11 IF(NDTHF.EQ.0) GO TO 111
      CALL INTRPC(DTHF,DELB,DELE,DDEL,DEL1,DTHF1,DTDD1)
      CALL INTRPC(DTHF,DELB,DELE,DDEL,DEL2,DTHF2,DTDD2)
  111 IF(NDTHR.EQ.0) GO TO 112
      CALL INTRPC(DTHR,DELB,DELE,DDEL,DEL3,DTHR3,DTDD3)
      CALL INTRPC(DTHR,DELB,DELE,DDEL,DEL4,DTHR4,DTDD4)
  112 U1 = U-(TF02+DTHF1)*R+ZFD1*Q
      U2 = U+(TF02+DTHF2)*R+ZFD2*Q
      U3 = U-(TR02+DTHR3)*R + ZRD3*Q
      U4 = U+(TR02+DTHR4)*R + ZRD4*Q
      GO TO 13
C
C  SUSPENSION OPTION 2, SOLID FRONT AND REAR AXLES
C
   12 U1 = U-(TF02-RFPF)*R+(ZFD1RF+TPF)*Q
      U2 = U+(TF02+RFPF)*R+(ZFD1RF-TPF)*Q
      U3 = U-(TR02-RPR)*R +(ZRD3R+TPR)*Q
      U4 = U+(TR02+RPR)*R +(ZRD3R-TPR)*Q
   13 CONTINUE
C             FORMERLY, TIRFRC(1) WAS CALLED FROM VGURNT SEPARATELY FOR
C         EACH WHEEL. THE SUM OF THE FORCES FOR ALL WHEELS WAS THEREFOR
C            NOT ZEROED IN TIRFRC BUT IN VPOS FOR EACH RUNGE-KUTTA STEP
C            SFXU,SFYU,SFZU
C         SFYUF AND SFYUR NO LONGER USED
      SFYUF = 0.0
      SFYUR = 0.0
    2 AMTX(1,1) = COSTH*COSPS
      AMTX(2,1) = COSTH*SINPS
      AMTX(3,1) = -SINTH
      AMTX(1,2) = -COSPH*SINPS+SINPH*SINTH*COSPS
      AMTX(2,2) = COSPH*COSPS+SINPH*SINTH*SINPS
      AMTX(3,2) = COSTH*SINPH
      AMTX(1,3) = SINPH*SINPS+COSPH*SINTH*COSPS
      AMTX(2,3) = -COSPS*SINPH+COSPH*SINTH*SINPS
      AMTX(3,3) = COSTH*COSPH
      CAY = AMTX(1,2)
```

```
      CBY = AMTX(2,2)
      CGY = AMTX(3,2)
      CAX = AMTX(1,1)
      CBX = AMTX(2,1)
      CGX = AMTX(3,1)
C
      IF(ISUS.EQ.2) GO TO 21
      YTMP = TFO2+DTHF1
      ZTMP = ZFD1
      GO TO 31
   21 YTMP = TFO2-RFPF
      ZTMP = ZFO+DEL1+TPF
   31 X1P = XCP+AMTX(1,1)*A+AMTX(1,2)*YTMP+AMTX(1,3)*ZTMP
      Y1P = YCP+AMTX(2,1)*A+AMTX(2,2)*YTMP+AMTX(2,3)*ZTMP
      Z1P = ZCP+AMTX(3,1)*A+AMTX(3,2)*YTMP+AMTX(3,3)*ZTMP
      IF(ISUS.EQ.2) GO TO 22
      YTMP = -TFO2-DTHF2
      ZTMP = ZFD2
      GO TO 32
   22 YTMP = -TFO2-RFPF
      ZTMP = ZFO+DEL2-TPF
   32 X2P = XCP+AMTX(1,1)*A+AMTX(1,2)*YTMP+AMTX(1,3)*ZTMP
      Y2P = YCP+AMTX(2,1)*A+AMTX(2,2)*YTMP+AMTX(2,3)*ZTMP
      Z2P = ZCP+AMTX(3,1)*A+AMTX(3,2)*YTMP+AMTX(3,3)*ZTMP
      IF(ISUS.EQ.1) GO TO 23
      YTMP = TRO2-RPR
      ZTMP = ZRO+DEL3+TPR
      GO TO 33
   23 YTMP = TRO2+DTHR3
      ZTMP = ZRD3
   33 X3P = XCP-AMTX(1,1)*B+AMTX(1,2)*YTMP+AMTX(1,3)*ZTMP
      Y3P = YCP-AMTX(2,1)*B+AMTX(2,2)*YTMP+AMTX(2,3)*ZTMP
      Z3P = ZCP-AMTX(3,1)*B+AMTX(3,2)*YTMP+AMTX(3,3)*ZTMP
      IF(ISUS.EQ.1) GO TO 24
      YTMP = -TRO2-RPR
      ZTMP = ZRO+DEL3-TPR
      GO TO 34
   24 YTMP = -TRO2-DTHR4
      ZTMP = ZRD4
   34 X4P = XCP-AMTX(1,1)*B+AMTX(1,2)*YTMP+AMTX(1,3)*ZTMP
      Y4P = YCP-AMTX(2,1)*B+AMTX(2,2)*YTMP+AMTX(2,3)*ZTMP
      Z4P = ZCP-AMTX(3,1)*B+AMTX(3,2)*YTMP+AMTX(3,3)*ZTMP
C
C     QUADRATIC INTERPOLATION SUBROUTINE INTRPL,ADDITIONAL ENTRY INTRPC
C
C
      IF(ISUS.EQ.2) GO TO 50
      CALL INTRPC(PHIC,DELB,DELE,DDEL,DEL1,PHI1,SLOPE1)
      PHI1 = PHI1*RAD
      SLOPE1 = SLOPE1*RAD
      PHI1D = SLOPE1*DEL1D
```

```
      CALL INTRPC(PHIC,DELB,DELE,DDEL,DEL2,PHI2,SLOPE2)                 VPOS2030
      PHI2 = -PHI2*RAD                                                  VPOS2040
      SLOPE2 = -SLOPE2*RAD                                              VPOS2050
      PHI2D = SLOPE2*DEL2D                                              VPOS2060
      GO TO 51                                                          VPOS2070
   50 PHI1 = PHIF                                                       VPOS2080
      PHI2 = PHIF                                                       VPOS2090
      PHI1D = PHIFD                                                     VPOS2100
      PHI2D = PHIFD                                                     VPOS2110
   51 IF(ISUS.EQ.1) GO TO 52                                            VPOS2120
      PHI3 = PHIR                                                       VPOS2130
      PHI4 = PHIR                                                       VPOS2140
      PHI3D = PHIRD                                                     VPOS2150
      PHI4D = PHIRD                                                     VPOS2160
      GO TO 53                                                          VPOS2170
   52 CALL INTRPC(PHIRC,DELB,DELE,DDEL,DEL3,PHI3,SLOPE3)                VPOS2180
      PHI3 = PHI3*RAD                                                   VPOS2190
      SLOPE3 = SLOPE3*RAD                                               VPOS2200
      PHI3D = SLOPE3*DEL3D                                              VPOS2210
      CALL INTRPC(PHIRC,DELB,DELE,DDEL,DEL4,PHI4,SLOPE4)                VPOS2220
      PHI4 = -PHI4*RAD                                                  VPOS2230
      SLOPE4 = -SLOPE4*RAD                                              VPOS2240
      PHI4D = SLOPE4*DEL4D                                              VPOS2250
   53 CONTINUE                                                          VPOS2260
C                                                                       VPOS2270
   40 IF(INDCRB.EQ.0) GO TO 5                                           VPOS2280
      IF(IHIT.EQ.1.OR.INDCRB.LT.0) GO TO 6                              VPOS2290
    5 CALL DRIVER(PSICON,PSISLP,J)                                      VPOS2300
      IF(J.NE.0) GO TO 5001                                             VPOS2310
      PSICON = 0.0                                                      VPOS2320
      PSISLP = 0.0                                                      VPOS2330
      IF(NTBL1.NE.0) CALL INTRPC(PSIF,TB,TE,TINCR,T,PSICON,PSISLP)      VPOS2340
      PSICON = PSICON*RAD                                               VPOS2350
      PSISLP=PSISLP*RAD                                                 VPOS2360
 5001 CONTINUE                                                          VPOS2370
C     FORMERLY PSIFP=PSI1,NO LONGER USED.FORMERLY PSIFID=(PSI1-PSIFP)/DTVPOS2380
      PSI1 = PSICON                                                     VPOS2390
      PSIFID = PSISLP                                                   VPOS2400
      PSIFI = PSI1                                                      VPOS2410
      GO TO 7                                                           VPOS2420
    6 PSI1 = PSIFI                                                      VPOS2430
    7 PSI2 = PSI1                                                       VPOS2440
C                                                                       VPOS2450
      IF(ISUS.EQ.1) GO TO 54                                            VPOS2460
      PSI3 = AKRS*PHIR                                                  VPOS2470
      PSI4 = PSI3                                                       VPOS2480
      RETURN                                                            VPOS2490
   54 PSI3 = AKDS+AKDS1*DEL3+AKDS2*DEL3**2+AKDS3*DEL3**3                VPOS2500
      PSI4 = -(AKDS+AKDS1*DEL4+AKDS2*DEL4**2+AKDS3*DEL4**3)             VPOS2510
      RETURN                                                            VPOS2520
      END                                                               VPOS2530
```

```
      SUBROUTINE WHEEL(/AKT/,/SIGT/,/XLAMT/,/RWHJB/,/RWHJE/,/DRWHJ/,
     1 /NFJP/,/RW/,FJP,/NO/)
C              HVOSM-VD2 VERSION
C              REVISED OCTOBER 1975   CALSPAN CORPORATION
      DIMENSION FJP(50)
    1 DA = 4.0*0.01745
      FJP(1) = 0.0
      N = NFJP
      IF (N.LE.NO) GO TO 3
      PRINT 2,N,NO
2        FORMAT ('ODIM. FOR FJP TOO SMALL,',I6,' NEEDED.', I6,' PROVIDED.
     1 ')
      STOP
3     CONTINUE
      NL = N-1
      DD = (RWHJE-RWHJB)/FLOAT(NL)
      DDK = DD*AKT
      K = 0
      D = 0.0
      DO 10  J=2,N
      FJP(J) = FJP(J-1)+DDK
      D = D+DD
      IF (K.NE.0) GO TO 10
      IF (D.LT.SIGT) GO TO 10
      X = DDK
      DDK = DDK*XLAMT
      FJP(J) = FJP(J)+(DDK-X)*(D-SIGT)/DD
      K = 1
   10 CONTINUE
   15 R = RW
      DO 19  J=2,N
      B = 1.0
      DDK = DD/R
      Z=DDK
  200 ANG = 0.0
      F = Z*B
  201 ANG = ANG+DA
      Y=1-Z
      X = COS(ANG)
      IF(X.LE.Y) GO TO 16
      F = F+2.0*(X-Y)*B
      GO TO 201
   16 B = FJP(J)/F
      FJP(J) = DDK*B
      IF (J.EQ.N) GO TO 1901
      I=J+1
      DO 18  L=I,N
      Z=Z+DDK
  300 ANG = 0.0
```

```
      F = Z*B                                                    WHEE0500
  301 ANG = ANG+DA                                               WHEE0510
      Y=1-Z                                                      WHEE0520
      X = COS(ANG)                                               WHEE0530
      IF(X.LE.Y) GO TO 18                                        WHEE0540
      F = F+2.0*(X-Y)*B                                          WHEE0550
      GO TO 301                                                  WHEE0560
   18 FJP(L) = FJP(L)-F                                          WHEE0570
   19 R = R-DD                                                   WHEE0580
 1901 DD =0.0                                                    WHEE0590
      DO 20 J=2,N                                                WHEE0600
      DD=DD+FJP(J)                                               WHEE0610
 20   FJP(J)=FJP(J-1)+DD                                         WHEE0620
      RETURN                                                     WHEE0630
      END                                                        WHEE0640
```

4. SYSTEM REQUIREMENTS

The HVOSM is executed at Calspan Corporation on an IBM/370 Model 165 under the System 370 Operating System. The source programs are compiled with the IBM Fortran H compiler. Input requirements consist of a card reader (Fortran unit 5), a sequential data set (FORTRAN unit 2) for temporary storage of the card input, and a sequential data set containing road roughness data (FORTRAN unit 4). Output requirements consist of two sequential data sets (FORTRAN units 1 and 3) which store certain data for subsequent processing. Unit 1 is used by the HVOSM Vehicle Graphics Program. Unit 3 is currently not used but is intended to store data for subsequent time history plotting. In addition, FORTRAN units 6 and 11 through 30 are used for printed output.

The JCL required to execute the HVOSM using the loader from object and/or load modules is illustrated in Figure 4.1-1, where DSHVOSV2 is the HVOSM load module name.

The Calspan procedure LOADGO is shown in Figure 4.1-2. The HVOSM program version to be executed is stored as module name as a member of the partitioned data set LOADLIB, and core storage size (GCORE) varies as a function of program version and buffer size.

Approximate core storage requirements for each program version, including system routines but excluding I/O buffers, are indicated below.

HVOSM-RD2	133200 bytes
HVOSM-VD2	148300 bytes

```
//  EXEC LOADGO,GCORE=320K,GTIME='(1,00)'
//GO.SYSLIN DD DSN=LOADLIB(DSHVOSR2),DISP=SHR
//GO.FT01F001 DD UNIT=9TRACK,DSN=LCDS.ROLL,DISP=(NEW,CATLG),
// DCB=(RECFM=VBS,LRECL=200,BLKSIZE=8004),LABEL=(1,,,OUT,RETPD=100)
//GO.FT02F001 DD DSN=&&DSIN,UNIT=SYSDA,DISP=(NEW,DELETE),
// DCB=(RECFM=FB,LRECL=80,BLKSIZE=6400),SPACE=(TRK,(1,1),RLSE)
//GO.FT03F001 DD DUMMY
//GO.FT04F001 DD DUMMY
//GO.FT11F001 DD SYSOUT=A,SPACE=(TRK,(0,15),RLSE),
// DCB=(RECFM=VBA,BLKSIZE=6447,LRECL=137,BUFNO=2)
//GO.FT12F001 DD SYSOUT=A,SPACE=(TRK,(0,15),RLSE),
// DCB=(RECFM=VBA,BLKSIZE=6447,LRECL=137,BUFNO=2)
//GO.FT13F001 DD SYSOUT=A,SPACE=(TRK,(0,15),RLSE),
// DCB=(RECFM=VBA,BLKSIZE=6447,LRECL=137,BUFNO=2)
//GO.FT14F001 DD SYSOUT=A,SPACE=(TRK,(0,15),RLSE),
// DCB=(RECFM=VBA,BLKSIZE=6447,LRECL=137,BUFNO=2)
//GO.FT15F001 DD SYSOUT=A,SPACE=(TRK,(0,15),RLSE),
// DCB=(RECFM=VBA,BLKSIZE=6447,LRECL=137,BUFNO=2)
//GO.FT16F001 DD SYSOUT=A,SPACE=(TRK,(0,15),RLSE),
// DCB=(RECFM=VBA,BLKSIZE=6447,LRECL=137,BUFNO=2)
//GO.FT17F001 DD SYSOUT=A,SPACE=(TRK,(0,15),RLSE),
// DCB=(RECFM=VBA,BLKSIZE=6447,LRECL=137,BUFNO=2)
//GO.FT18F001 DD SYSOUT=A,SPACE=(TRK,(0,15),RLSE),
// DCB=(RECFM=VBA,BLKSIZE=6447,LRECL=137,BUFNO=2)
//GO.FT19F001 DD SYSOUT=A,SPACE=(TRK,(0,15),RLSE),
// DCB=(RECFM=VBA,BLKSIZE=6447,LRECL=137,BUFNO=2)
//GO.FT20F001 DD SYSOUT=A,SPACE=(TRK,(0,15),RLSE),
// DCB=(RECFM=VBA,BLKSIZE=6447,LRECL=137,BUFNO=2)
//GO.FT21F001 DD SYSOUT=A,SPACE=(TRK,(0,15),RLSE),
// DCB=(RECFM=VBA,BLKSIZE=6447,LRECL=137,BUFNO=2)
//GO.FT22F001 DD SYSOUT=A,SPACE=(TRK,(0,15),RLSE),
// DCB=(RECFM=VBA,BLKSIZE=6447,LRECL=137,BUFNO=2)
//GO.FT23F001 DD SYSOUT=A,SPACE=(TRK,(0,15),RLSE),
// DCB=(RECFM=VBA,BLKSIZE=6447,LRECL=137,BUFNO=2)
//GO.FT24F001 DD SYSOUT=A,SPACE=(TRK,(0,15),RLSE),
// DCB=(RECFM=VBA,BLKSIZE=6447,LRECL=137,BUFNO=2)
//GO.FT25F001 DD SYSOUT=A,SPACE=(TRK,(0,15),RLSE),
// DCB=(RECFM=VBA,BLKSIZE=6447,LRECL=137,BUFNO=2)
//GO.FT26F001 DD SYSOUT=A,SPACE=(TRK,(0,15),RLSE),
// DCB=(RECFM=VBA,BLKSIZE=6447,LRECL=137,BUFNO=2)
//GO.FT27F001 DD SYSOUT=A,SPACE=(TRK,(0,15),RLSE),
// DCB=(RECFM=VBA,BLKSIZE=6447,LRECL=137,BUFNO=2)
//GO.FT28F001 DD SYSOUT=A,SPACE=(TRK,(0,15),RLSE),
// DCB=(RECFM=VBA,BLKSIZE=6447,LRECL=137,BUFNO=2)
//GO.FT29F001 DD SYSOUT=A,SPACE=(TRK,(0,15),RLSE),
// DCB=(RECFM=VBA,BLKSIZE=6447,LRECL=137,BUFNO=2)
//GO.FT30F001 DD SYSOUT=A,SPACE=(TRK,(0,15),RLSE),
// DCB=(RECFM=VBA,BLKSIZE=6447,LRECL=137,BUFNO=2)
//GO.SYSIN DD *
```

HVOSM DATA DECK

.

.

.

Figure 4.1-1 HVOSM JOB CONTROL LANGUAGE

```
// EXEC LOADGO,GLINES=15000,GTIME='(,30)'
***  CAL PROCEDURES  ASMFG, ASMGG, ASMHG, FORTGG, FORTHG, GO, LOADGO    C(
***
XX   PROC LCOPY=1,LLINES=1000,LLIB=DUMMY,LPARM=,ENTRY=MAIN,
XX          LOUT=A,LFORMS=STD1,GOUT=A,GFORMS=STD1,
XX          GCARDS=2000,GOUT=A,GFORMS=STD1,GCOPY=1,GLINES=5000,GCORE=128K,
XX          GTIME='(,20)',GPARM=,DUMP=DEFAULT,
XX          PLOTTER=NONE,LONG=X,PAPER=SG
***
XXGO   EXEC  PGM=LOADER,PARM='SIZE=&GCORE,&LPARM,EP=&ENTRY/&GPARM',
IEF653I SUBSTITUTION JCL - PGM=LOADER,PARM='SIZE=128K,,EP=MAIN/',
XX    REGION=&GCORE,TIME=&GTIME,ACCT=&DUMP
IEF653I SUBSTITUTION JCL - REGION=128K,TIME=(,30),ACCT=DEFAULT
***
XXFT05F001 DD DDNAME=SYSIN
***
XXFT06F001 DD SYSOUT=(&GOUT,COPY&GCOPY,&GFORMS),SPACE=(4,&GLINES,RLSE),
IEF653I SUBSTITUTION JCL - SYSOUT=(A,COPY1,STD1),SPACE=(4,15000,RLSE),
XX                 UNIT=SYSOUT,
XX                 DCB=(BLKSIZE=6447,RECFM=VBA,LRECL=137,BUFNO=2)
***
XXFT07F001 DD SYSOUT=B,UNIT=SYSOUT,
XX                 SPACE=(1,&GCARDS,RLSE),
IEF653I SUBSTITUTION JCL - SPACE=(1,2000,RLSE),
XX                 DCB=(BLKSIZE=3120,RECFM=FB,LRECL=80,BUFNO=2)
***
XXPLOTLIB   DD  DSN=SYSTEM.GENSUBS,DISP=SHR
***
XXPLOTTER  DD  DDNAME=&PLOTTER
IEF653I SUBSTITUTION JCL - DDNAME=NONE
***
XXCALCOMP DD SYSOUT=(C,PLOTWRTR,&PAPER),UNIT=SYSDA,
IEF653I SUBSTITUTION JCL - SYSOUT=(C,PLOTWRTR,SG),UNIT=SYSDA,
XX             DCB=(LRECL=400,BLKSIZE=4000,BUFNO=2),
XX             SPACE=(TRK,(100,50),RLSE),FCB=&LONG.&PAPER
IEF653I SUBSTITUTION JCL - SPACE=(TRK,(100,50),RLSE),FCB=XSG
***
XXLDX    DD DSN=&&&PLOTTER,UNIT=SYSDA,DISP=(MOD,PASS),
IEF653I SUBSTITUTION JCL - DSN=&&NONE,UNIT=SYSDA,DISP=(MOD,PASS),
XX          SPACE=(CYL,(20,10)),FCB=&LONG
IEF653I SUBSTITUTION JCL - SPACE=(CYL,(20,10)),FCB=X
***
XXSYSLIB  DD DSN=&LLIB,DISP=SHR,DCB=(RECFM=U,BLKSIZE=13030)
IEF653I SUBSTITUTION JCL - DSN=DUMMY,DISP=SHR,DCB=(RECFM=U,BLKSIZE=13030)
XX          DD  DSN=SYSTEM.FORTSUBS,DISP=SHR
XX          DD  DSN=SYS1.FORTLIB,DISP=SHR
XX          DD  DSN=SYSTEM.GENSUBS,DISP=SHR
XX          DD  DSN=SYSTEM.IMSL,DISP=SHR
***
XXSYSLOUT DD SYSOUT=(&LOUT,COPY&LCOPY,&LFORMS),SPACE=(1,&LLINES,RLSE),
IEF653I SUBSTITUTION JCL - SYSOUT=(A,COPY1,STD1),SPACE=(1,1000,RLSE),
XX   UNIT=SYSDA,
XX        DCB=(BLKSIZE=3146,RECFM=FBSA,LRECL=121,BUFNO=2)
***
XXSYSUDUMP  DD  SYSOUT=A,UNIT=SYSOUT,SPACE=(TRK,(0,30),RLSE)
***
//GO.SYSLIN DD DSN=LOADLIB(DSRCMOD),DISP=SHR
//GO.SYSIN DD *
```

Figure 4.1-2 Calspan Procedure LOADGO

5. HVOSM PREPROCESSING PROGRAM

A listing os the HVOSM Preprocessing Program routines is provided in this section.

```
      REAL*4 LW
      READ(5,100) IVEH,IVER,IOUT,IRD,IFD,LW
  100 FORMAT(5I4,F10.0)
      IF(IVEH.NE.0) CALL VEHLIB(IVEH,IVER,IOUT)
      IF(LW.NE.0.0) CALL VEHCAL(LW)
      IF(IRD.EQ.0) GO TO 10
      READ(5,101) S1,S2,S3,Y1,Y2,R,B,DBS
  101 FORMAT(8F8.0)
      CALL RBDTCH(S1,S2,S3,Y1,Y2,R,B,DBS)
   10 IF(IFD.EQ.0) GO TO 99
      READ(5,102) S1,S2,S3,Y1,Y2,Y3,R,B1,B2,DBS
  102 FORMAT(10F8.0)
      CALL FBDTCH(S1,S2,S3,Y1,Y2,Y3,R,B1,B2,DBS)
   99 STOP
      END
```

```
      SUBROUTINE VEHCAL(LW)
      DIMENSION PS2PI(3),PS2I(3),PPI(2),PSPI(3)
      REAL*4LW,LW2,LW3
      DATA PS2PI/4HLB-S,4HEC**,4H2/IN/  ,
     1     PS2I/4HLB-S,4HEC**,4H2-IN/  ,
     2     PSPI/4HLB-S,4HEC/I,4HN   /  ,
     3      PPI/4HLB/I,4HN   /         ,
     4      DIN/4HIN  /                ,
     5      PLB/4HLB  /
      DATA G/386.4/, PI/3.1415927/
C********
C      .CALCULATION OF VEHICLE PARAMETERS FROM:
C     BASSO,G.L., "FUNCTIONAL DERIVATION OF VEHICLE PARAMETERS FOR
C     DYNAMIC STUDIES", NATIONAL RESEARCH COUNCIL OF CANADA, NATIONAL
C     AERONAUTICAL ESTABLISHMENT, REPORT NO. LTR-ST-747, SEP 1974
C*******
      LW2 = LW*LW
      LW3= LW2*LW
      WT = 2.451E-3*LW3
      WUT = 126.6+0.111*WT
      WUF = 0.385*WUT
      WUR = WUT-WUF
      WS = WT-WUT
      WFT = (62.727-0.0629*LW)*WT/100.
      WRT = WT-WFT
      WFS = WFT-WUF
      WRS = WRT-WUR
      A = WRS*LW/WS
      B = LW-A
      XMS = WS/G
      XMUF = WUF/G
      XMUR = WUR/G
      TF = 12.571+0.419*LW
      TR = 11.211+0.428*LW
      XIZ = XMS*26.352*WT**0.577
      XIX = XMS*4.752*WT**0.546
      XIYT = (3.1104*WT**1.82)/G
      XIYU = XMUF*(144.+A*A)+XMUR*(144.+B*B)
      XIY = XIYT-XIYU
      XIXZ = 0.0
      XIR = 0.12484*XMUR*TR*TR
      FN = 1.696-1.415E-4*WT
      SK = 4.0*FN*FN*PI*PI*XMS
      RK = 42.17+0.125E-2*WT
      AKF = RK*SK/200.
      AKR = 0.5*SK-AKF
      CF = 0.246*SQRT(AKF*WFS/(2.0*G))
      CR = 0.416*SQRT(AKR*WRS/(2.0*G))
      TS = 0.702*TR
```

```
      WRITE(6,100)  LW   ,DIN ,WT   ,PLB ,WS   ,PLB ,WUF ,PLB ,WUR ,PLB
      WRITE(6,101)  XMS       ,PS2PI     ,XMUF      ,PS2PI     ,
     1              XMUR      ,PS2PI     ,XIX       ,PS2I      ,
     2              XIY       ,PS2I      ,XIZ       ,PS2I      ,
     3              XIXZ      ,PS2I      ,XIR       ,PS2I
      WRITE(6,102)  A         ,DIN       ,B         ,DIN       ,
     1              TF        ,DIN       ,TR        ,DIN       ,
     2              TS        ,DIN       ,AKF       ,PPI       ,
     3              AKR       ,PPI       ,CF        ,PSPI      ,
     4              CR        ,PSPI
  100 FORMAT(1H1
     1  9X,36HWHEELBASE                           LW   =,F10.3,2X,A4  /
     2 10X,36HTOTAL VEHICLE WEIGHT                WT   =,F10.3,2X,A4  /
     3 10X,36HSPRUNG WEIGHT                       WS   =,F10.3,2X,A4  /
     4 10X,36HFRONT UNSPRUNG WEIGHT               WUF  =,F10.3,2X,A4  /
     5 10X,36HREAR UNSPRUNG WEIGHT                WUR  =,F10.3,2X,A4  )
  101 FORMAT(1H0,19X,22HHVOSM INPUT PARAMETERS,25X,10HCARD FIELD  //
     1 9X,31HSPRUNG MASS                    XMS  =,F10.3,2X,3A4,3X,7H201   1/
     2 9X,31HFRONT UNSPRUNG MASS            XMUF =,F10.3,2X,3A4,3X,7H201   2/
     3 9X,31HREAR UNSPRUNG MASS             XMUR =,F10.3,2X,3A4,3X,7H201   3/
     4 9X,31HROLL INERTIA                   XIX  =,F10.3,2X,3A4,3X,7H201   4/
     5 9X,31HPITCH INERTIA                  XIY  =,F10.3,2X,3A4,3X,7H201   5/
     6 9X,31HYAW INERTIA                    XIZ  =,F10.3,2X,3A4,3X,7H201   6/
     7 9X,31HROLL-YAW INERTIA PRODUCT       XIXZ =,F10.3,2X,3A4,3X,7H201   7/
     8 9X,31HREAR AXLE ROLL INERTIA         XIR  =,F10.3,2X,3A4,3X,7H201   8)
  102 FORMAT(1H ,
     1 8X,31HSPRUNG MASS CG. LOCATION       A    =,F10.3,2X,A4,11X,7H202   1/
     2 9X,31H                               B    =,F10.3,2X,A4,11X,7H202   2/
     3 9X,31HFRONT TRACK                    TF   =,F10.3,2X,A4,11X,7H202   3/
     4 9X,31HREAR TRACK                     TR   =,F10.3,2X,A4,11X,7H202   4/
     5 9X,31HREAR SPRING TRACK              TS   =,F10.3,2X,A4,11X,7H202   6/
     6 9X,31HFRONT SPRING RATE              AKF  =,F10.3,2X,2A4,7X,7H204   1/
     7 9X,31HREAR SPRING RATE               AKR  =,F10.3,2X,2A4,7X,7H205   1/
     8 9X,31HFRONT DAMPING COEF.            CF   =,F10.3,2X,3A4,3X,7H206   1/
     9 9X,31HREAR DAMPING COEF.             CR   =,F10.3,2X,3A4,3X,7H206   4)
      RETURN
      END
```

```
      SUBROUTINE VEHLIB(IVEH,IVER,IOUT)
      COMMON /VDATA/ VEH(10,50,10),ZCOND(5,10),NRDC(10),NVDC(10)
      REAL*8 VEH
      WRITE(6,1000)
 1000 FORMAT(1H1,
     1 10X,11H***CAUTION:    /
     2 10X,57H  VALUES OF ZF, ZR GIVEN IN FIELDS 7, 8 OF CARD 203 ARE /
     3 10X,57HBASED ON, AND ARE CONSISTENT WITH, LOADING CONDITIONS,   /
     4 10X,57HTIRE RADII AND TIRE RATES AS PER REFERENCE INDICATED IN  /
     5 10X,57HBLOCK DATA SUBROUTINE.  THE VALUES USED IN DETERMINING   /
     6 10X,57HZF, ZR ARE PRINTED WITH THE DATA SET BELOW.  IF CHANGES  /
     7 10X,57HARE MADE TO THE INITIAL CENTER OF GRAVITY ELEVATION, TIRE/
     8 10X,57HRADII OR RATES, INITIAL EQUILIBRIUM WILL NOT BE MAINTAIN-/
     9 10X,57HED IF ZF, ZR ARE INPUT.  BY DELETENG ZF, ZR FROM CARD 203/
     A 10X,57HINITIAL EQUILIBRIUM CAN BE ASSURED BY AN AUTOMATIC INT-  /
     B 10X,57HERNAL CALL TO SUBROUTINE INITEQ BASED ON THE SUPLIED     /
     C 10X,50HTIRE PROPERTIES AND CENTER OF GRAVITY LOCATION.      // )
      N = NRDC(IVEH)
      IF(IVER.EQ.2) N = NVDC(IVEH)
      WRITE(6,1001) ((VEH(I,J,IVEH),I=1,10),J=1,N)
 1001 FORMAT(5X,10A8)
      WRITE(6,1002) (ZCOND(I,IVEH),I=1,5)
 1002 FORMAT(1H0,
     1  9X,56H  VALUES OF ZF, ZR ON CARD 203 WERE COMPUTED BASED ON   /
     2 10X,26HTHE FOLLOWING PARAMETERS :   /
     3 10X,36HSPRUNG MASS CG HEIGHT ABOVE GROUND =,F10.3,2X,2HIN   /
     4 10X,20HTIRE RADII    FRONT =,F10.3,2X,2HIN  /
     5 10X,20H              REAR  =,F10.3,2X,2HIN  /
     6 10X,20HTIRE RATES    FRONT =,F10.3,2X,5HLB/IN  /
     7 10X,20H              REAR  =,F10.3,2X,5HLB/IN  )
      IF(IOUT.NE.0) WRITE(IOUT,1003) ((VEH(I,J,IVEH),I=1,10),J=1,N)
 1003 FORMAT(10A8)
      RETURN
      END
```

```
      BLOCK DATA
      COMMON /VDATA/ VEH(10,50,10),ZCOND(5,10),NRDC(10),NVDC(10)
      DIMENSION V11(10,20),V12(10,20),V13(10,20),V14(10,20),V15(10,20),
     1          V21(10,20),V22(10,20),V31(10,20),V32(10,20),
     2          V41(10,20),V42(10,20),V51(10,20),V52(10,20),
     3          V61(10,20),V62(10,20)
      REAL*8 VEH,V11,V12,V13,V14,V15,V21,V22,V31,V32,V41,V42,V51,V52,
     1       V61,V62
      EQUIVALENCE (V11(1,1),VEH(1,1,1)), (V12(1,1),VEH(1,10,1)),
     1            (V13(1,1),VEH(1,19,1)),(V14(1,1),VEH(1,28,1)),
     2            (V15(1,1),VEH(1,37,1)),
     3            (V21(1,1),VEH(1,1,2)), (V22(1,1),VEH(1,10,2)),
     4            (V31(1,1),VEH(1,1,3)), (V32(1,1),VEH(1,10,3)),
     5            (V41(1,1),VEH(1,1,4)), (V42(1,1),VEH(1,10,4)),
     6            (V51(1,1),VEH(1,1,5)), (V52(1,1),VEH(1,10,5))
     7            (V61(1,1),VEH(1,1,6)), (V62(1,1),VEH(1,10,6))
      DATA NRDC/18,14,14,14,15,10,4*0/
      DATA NVDC/38,15,15,15,16,10,4*0/
      DATA ZCOND/23.0   ,14.0   ,14.0   ,1098.  ,1098.  ,
     1           24.6   ,14.4   ,14.4   ,1210.  ,1680.  ,
     2           24.03  ,13.2   ,13.2   ,1450.  ,1450.  ,
     3           19.48  ,12.8   ,12.8   ,1500.  ,1500.  ,
     4           23.17  ,12.6   ,12.6   ,760.   ,1060.  ,
     5           19.85  ,11.83  ,11.83  ,1240.  ,1240.  /
C
C  1963 FORD DATA (VEH. NO. 1) FROM REFERENCE 1
C
      DATA V11/
     1 8H     1963, 8H FORD GA, 8HLAXY FOU, 8HR - DOOR, 8H SEDAN  ,
     2 8H         , 8H        , 8H        , 8H        , 8H     200,
     3 8H10.818   , 8H0.608   , 8H0.945   , 8H6000.   , 8H35477.  ,
     4 8H35800.   , 8H-192.   , 8H435.6   , 8H        , 8H     201,
     5 8H54.63    , 8H64.62   , 8H61.2    , 8H60.5    , 8H-2.0    ,
     6 8H46.52    , 8H        , 8H        , 8H        , 8H     202,
     7 8H         , 8H        , 8H        , 8H        , 8H        ,
     8 8H         , 8H10.138  , 8H12.038  , 8H        , 8H     203,
     9 8H131.0    , 8H300.    , 8H600.    , 8H300.    , 8H600.    ,
     A 8H.05      , 8H-3.0    , 8H5.0     , 8H        , 8H     204,
     B 8H194.0    , 8H300.    , 8H600.    , 8H300.    , 8H600.    ,
     C 8H.05      , 8H-4.0    , 8H4.5     , 8H        , 8H     205,
     D 8H1.3      , 8H58.0    , 8H0.001   , 8H1.75    , 8H97.0    ,
     E 8H0.001    , 8H        , 8H        , 8H        , 8H     206,
     F 8H266000.  , 8H59244.  , 8H0.059   , 8H        , 8H        ,
     G 8H         , 8H        , 8H        , 8H        , 8H     207,
     H 8H492.0    , 8H600.    , 8H0.4     , 8H5000.   , 8H0.075   ,
     I 8H1.5      , 8H        , 8H        , 8H        , 8H     208/
      DATA V12/
     1 8H-5.0     , 8H5.0     , 8H1.0     , 8H        , 8H        ,
     2 8H         , 8H        , 8H        , 8H        , 8H     209,
```

```
3 8H-5.7     , 8H-3.9     , 8H-2.45    , 8H-1.3     , 8H-0.4     ,
4 8H0.3      , 8H0.6      , 8H0.65     , 8H0.3      , 8H    1 209,
5 8H-0.4     , 8H-1.3     , 8H         , 8H         , 8H         ,
6 8H         , 8H         , 8H         , 8H         , 8H    2 209,
7 8H-5.0     , 8H5.0      , 8H0.5      , 8H         , 8H         ,
8 8H         , 8H         , 8H         , 8H         , 8H      210,
9 8H.1079    , 8H.1053    , 8H.1030    , 8H.1011    , 8H.0994    ,
A 8H.0981    , 8H.0971    , 8H.0964    , 8H.0959    , 8H    1 210,
B 8H.0958    , 8H.0960    , 8H.0965    , 8H.0973    , 8H.0984    ,
C 8H.0998    , 8H.1015    , 8H.1035    , 8H.1058    , 8H    2 210,
D 8H.1085    , 8H.1114    , 8H.1147    , 8H         , 8H         ,
E 8H         , 8H         , 8H         , 8H         , 8H    3 210,
F 8H-5.0     , 8H5.0      , 8H5.0      , 8H         , 8H         ,
G 8H         , 8H         , 8H         , 8H         , 8H      211,
H 8H0.092    , 8H0.092    , 8H0.092    , 8H         , 8H         ,
I 8H         , 8H         , 8H         , 8H         , 8H    1 211/
 DATA V13/
1 8H0.0      , 8H12.2     , 8H6.5      , 8H13.6     , 8H1.0      ,
2 8H3.0      , 8H         , 8H         , 8H         , 8H      212,
3 8H1.0      , 8H1.0      , 8H1000.    , 8H1000.    , 8H110.     ,
4 8H192.     , 8H0.1      , 8H         , 8H         , 8H      213,
5 8H3.0      , 8H3.0      , 8H         , 8H         , 8H         ,
6 8H         , 8H         , 8H         , 8H         , 8H      214,
7 8H7.62     , 8H1.4      , 8H0.48     , 8H0.942    , 8H0.0      ,
8 8H3.12     , 8H6.21     , 8H6.43     , 8H4.62     , 8H    1 214,
9 8H1.0      , 8H9.25     , 8H0.384    , 8H0.0      , 8H10.0     ,
A 8H  10.E10, 8H  10.E10, 8H         , 8H         , 8H    2 214,
B 8H7.62     , 8H1.4      , 8H0.476    , 8H0.691    , 8H0.0      ,
C 8H3.12     , 8H6.21     , 8H6.43     , 8H4.62     , 8H    3 214,
D 8H1.0      , 8H9.25     , 8H0.381    , 8H0.0      , 8H10.0     ,
E 8H  10.E10, 8H  10.E10, 8H         , 8H         , 8H    4 214,
F 8H500.     , 8H4900.    , 8H400.     , 8H         , 8H         ,
G 8H         , 8H         , 8H         , 8H         , 8H      215,
H 8H500.     , 8H563.     , 8H594.     , 8H618.     , 8H630.     ,
I 8H621.     , 8H600.     , 8H561.     , 8H516.     , 8H    1 215/
 DATA V14/
1 8H480.     , 8H438.     , 8H420.     , 8H         , 8H         ,
2 8H         , 8H         , 8H         , 8H         , 8H    2 215,
3 8H0.0      , 8H-120.    , 8H-144.    , 8H-165.    , 8H-180.    ,
4 8H-192.    , 8H-204.    , 8H-216.    , 8H-231.    , 8H    3 215,
5 8H-249.    , 8H-267.    , 8H-288.    , 8H         , 8H         ,
6 8H         , 8H         , 8H         , 8H         , 8H    4 215,
7 8H0.0      , 8H1000.    , 8H20.0     , 8H         , 8H         ,
8 8H         , 8H         , 8H         , 8H         , 8H      216,
9 8H0.960    , 8H0.974    , 8H0.985    , 8H0.996    , 8H1.0      ,
A 8H1.030    , 8H1.010    , 8H1.0      , 8H0.995    , 8H    1 216,
B 8H0.982    , 8H0.972    , 8H0.952    , 8H0.930    , 8H0.907    ,
C 8H0.859    , 8H0.814    , 8H0.770    , 8H0.727    , 8H    2 216,
D 8H0.687    , 8H0.645    , 8H0.609    , 8H0.586    , 8H0.561    ,
E 8H0.536    , 8H0.515    , 8H0.550    , 8H0.488    , 8H    3 216,
F 8H0.475    , 8H0.465    , 8H0.454    , 8H0.444    , 8H0.441    ,
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     G 8H0.438   , 8H0.435   , 8H0.432   , 8H0.429   , 8H   4 216,
     H 8H0.425   , 8H0.422   , 8H0.419   , 8H0.416   , 8H0.414    ,
     I 8H0.410   , 8H0.407   , 8H0.404   , 8H0.401   , 8H   5 216/
      DATA V15/
     1 8H0.398   , 8H0.395   , 8H0.391   , 8H0.388   , 8H0.385    ,
     2 8H0.382   , 8H        , 8H        , 8H        , 8H   6 216,
     3 8H9.6136-5, 8H.02853  , 8H60.336  , 8H        , 8H         ,
     4 8H        , 8H        , 8H        , 8H        , 8H     217/
C
C  1971 DODGE DATA (VEH.NO. 2) FROM REFERENCE 2
C
      DATA V21/
     1 8H     1971, 8H DODGE C, 8HORONET  , 8HCURB LOA, 8HDING     ,
     2 8H        , 8H        , 8H        , 8H        , 8H     200,
     3 8H7.57    , 8H0.51    , 8H0.82    , 8H312.    , 8H22800.  ,
     4 8H22600.  , 8H530.    , 8H550.    , 8H        , 8H     201,
     5 8H47.7    , 8H70.3    , 8H59.8    , 8H61.8    , 8H        ,
     6 8H47.0    , 8H        , 8H        , 8H        , 8H     202,
     7 8H        , 8H        , 8H        , 8H        , 8H        ,
     8 8H        , 8H11.5    , 8H11.5    , 8H        , 8H     203,
     9 8H105.    , 8H84.0    , 8H0.0     , 8H483.0   , 8H0.0     ,
     A 8H0.5     , 8H-2.4    , 8H2.1     , 8H        , 8H     204,
     B 8H120.    , 8H204.    , 8H0.0     , 8H744.    , 8H0.0     ,
     C 8H0.5     , 8H-4.4    , 8H3.6     , 8H        , 8H     205,
     D 8H6.85    , 8H40.0    , 8H.01     , 8H5.48    , 8H38.0    ,
     E 8H.01     , 8H        , 8H        , 8H        , 8H     206,
     F 8H40400.  , 8H-5100.  , 8H0.02    , 8H        , 8H        ,
     G 8H        , 8H        , 8H        , 8H        , 8H     207,
     H 8H-3.0    , 8H3.0     , 8H1.0     , 8H        , 8H        ,
     I 8H        , 8H        , 8H        , 8H        , 8H     209/
      DATA V22/
     1 8H-.52    , 8H.04     , 8H.27     , 8H.31     , 8H.08     ,
     2 8H-.54    , 8H-.95    , 8H        , 8H        , 8H   1 209,
     3 8H-3.0    , 8H3.0     , 8H1.0     , 8H        , 8H        ,
     4 8H        , 8H        , 8H        , 8H        , 8H     210,
     5 8H.04     , 8H.07     , 8H.10     , 8H.13     , 8H.16     ,
     6 8H.19     , 8H.22     , 8H        , 8H        , 8H   1 210,
     7 8H-3.0    , 8H3.0     , 8H1.0     , 8H        , 8H        ,
     8 8H        , 8H        , 8H        , 8H        , 8H     211,
     9 8H.60     , 8H.45     , 8H.30     , 8H.15     , 8H0.0     ,
     A 8H-.15    , 8H-.30    , 8H        , 8H        , 8H   1 211,
     B 8H0.0     , 8H9.4     , 8H0.7     , 8H9.4     , 8H1.0     ,
     C 8H2.71    , 8H        , 8H        , 8H        , 8H     212/
C
C 1971 CHEVROLET DATA (VEH NO. 3) FROM REFERENCE 2
C
      DATA V31/
     1 8H     1971, 8H CHEVROL, 8HET BROOK, 8HWOOD STA, 8HTION WAG,
     2 8HON   CUR, 8HB LOADIN, 8HG       , 8H        , 8H     200,
     3 8H10.3    , 8H0.63    , 8H1.03    , 8H5920.   , 8H41400.  ,
     4 8H41700.  , 8H1790.   , 8H750.    , 8H        , 8H     201,
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     5 8H64.3     , 8H60.7     , 8H63.5     , 8H63.5     , 8H              ,       00001520
     6 8H45.3     , 8H         , 8H         , 8H         , 8H          202,        00001530
     7 8H         , 8H         , 8H         , 8H         , 8H              ,       00001540
     8 8H         , 8H11.1     , 8H10.8     , 8H         , 8H          203,        00001550
     9 8H141.     , 8H141.     , 8H0.0      , 8H451.2    , 8H0.0           ,       00001560
     A 8H0.5      , 8H-3.5     , 8H2.3      , 8H         , 8H          204,        00001570
     B 8H210.     , 8H189.     , 8H0.0      , 8H861.     , 8H0.0           ,       00001580
     C 8H0.5      , 8H-3.6     , 8H2.3      , 8H         , 8H          205,        00001590
     D 8H5.07     , 8H43.0     , 8H.01      , 8H4.41     , 8H73.0          ,       00001600
     E 8H.01      , 8H         , 8H         , 8H         , 8H          206,        00001610
     F 8H408000.  , 8H-62000.  , 8H0.033    , 8H         , 8H              ,       00001620
     G 8H         , 8H         , 8H         , 8H         , 8H          207,        00001630
     H 8H-4.0     , 8H3.0      , 8H1.0      , 8H         , 8H              ,       00001640
     I 8H         , 8H         , 8H         , 8H         , 8H          209/        00001650
      DATA V32/                                                                    00001660
     1 8H.28      , 8H.61      , 8H.79      , 8H.79      , 8H.5            ,       00001670
     2 8H0.0      , 8H-.83     , 8H-1.68    , 8H         , 8H        1 209,        00001680
     3 8H-4.0     , 8H3.0      , 8H1.0      , 8H         , 8H              ,       00001690
     4 8H         , 8H         , 8H         , 8H         , 8H          210,        00001700
     5 8H.25      , 8H.22      , 8H.19      , 8H.16      , 8H.13           ,       00001710
     6 8H.10      , 8H.07      , 8H.04      , 8H         , 8H        1 210,        00001720
     7 8H-4.0     , 8H4.0      , 8H4.0      , 8H         , 8H              ,       00001730
     8 8H         , 8H         , 8H         , 8H         , 8H          211,        00001740
     9 8H.09      , 8H.15      , 8H.21      , 8H         , 8H              ,       00001750
     A 8H         , 8H         , 8H         , 8H         , 8H        1 211,        00001760
     B 8H0.0      , 8H14.8     , 8H.07      , 8H14.8     , 8H1.0           ,       00001770
     C 8H3.08     , 8H         , 8H         , 8H         , 8H          212/        00001780
C                                                                                       1790
C  1971 PONTIAC DATA (VEH. NO. 4) FROM REFERENCE 2                                      1800
C                                                                                       1810
      DATA V41/                                                                    00001820
     1 8H    1971, 8H PONTIAC, 8H TRANS-A, 8HM  CURB  , 8HLOADING ,                00001830
     2 8H         , 8H         , 8H         , 8H         , 8H          200,        00001840
     3 8H8.0      , 8H0.53     , 8H0.82     , 8H2760.    , 8H18500.        ,       00001850
     4 8H18900.   , 8H230.     , 8H530.     , 8H         , 8H          201,        00001860
     5 8H40.      , 8H68.      , 8H61.9     , 8H60.4     , 8H              ,       00001870
     6 8H45.5     , 8H         , 8H         , 8H         , 8H          202,        00001880
     7 8H         , 8H         , 8H         , 8H         , 8H              ,       00001890
     8 8H         , 8H7.4      , 8H7.1      , 8H         , 8H          203,        00001900
     9 8H99.      , 8H99.      , 8H0.0      , 8H247.5    , 8H0.0           ,       00001910
     A 8H0.5      , 8H-2.0     , 8H2.5      , 8H         , 8H          204,        00001920
     B 8H147.     , 8H147.     , 8H0.0      , 8H588.     , 8H0.0           ,       00001930
     C 8H0.5      , 8H-3.3     , 8H3.7      , 8H         , 8H          205,        00001940
     D 8H7.28     , 8H3.5      , 8H.01      , 8H2.1      , 8H55.0          ,       00001950
     E 8H.01      , 8H         , 8H         , 8H         , 8H          206,        00001960
     F 8H356000.  , 8H630000.  , 8H-.008    , 8H         , 8H              ,       00001970
     G 8H         , 8H         , 8H         , 8H         , 8H          207,        00001980
     H 8H-2.0     , 8H4.0      , 8H1.0      , 8H         , 8H              ,       00001990
     I 8H         , 8H         , 8H         , 8H         , 8H          209/        00002000
      DATA V42/                                                                    00002010
     1 8H.54      , 8H.75      , 8H.75      , 8H.54      , 8H.10           ,       00002020
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     2 8H-.47     , 8H-.73     , 8H         , 8H         , 8H    1 209,      00002030
     3 8H-2.0     , 8H4.0      , 8H1.0      , 8H         , 8H         ,      00002040
     4 8H         , 8H         , 8H         , 8H         , 8H      210,      00002050
     5 8H.03      , 8H.06      , 8H.09      , 8H.12      , 8H.15      ,      00002060
     6 8H.18      , 8H.21      , 8H         , 8H         , 8H    1 210,      00002070
     7 8H-2.0     , 8H4.0      , 8H1.0      , 8H         , 8H         ,      00002080
     8 8H         , 8H         , 8H         , 8H         , 8H      211,      00002090
     9 8H.12      , 8H.135     , 8H.15      , 8H.165     , 8H.18      ,      00002100
     A 8H.195     , 8H.21      , 8H         , 8H         , 8H    1 211,      00002110
     B 8H0.0      , 8H8.0      , 8H0.7      , 8H8.0      , 8H1.0      ,      00002120
     C 8H3.42     , 8H         , 8H         , 8H         , 8H      212/      00002130
C                                                                               2140
C 1971 VOLKSWAGEN DATA (VEH NO. 5) FROM REFERENCE 2                             2150
C                                                                               2160
      DATA V51/                                                              00002170
     1 8H   1971  , 8HVOLKSWAG, 8HEN SUPER, 8H BEETLE  , 8H         ,      00002180
     2 8H         , 8H         , 8H         , 8H         , 8H      200,      00002190
     3 8H4.23     , 8H0.36     , 8H0.57     , 8H1300.    , 8H8900.    ,      00002200
     4 8H7900.    , 8H0.0      , 8H         , 8H         , 8H      201,      00002210
     5 8H57.1     , 8H38.7     , 8H53.8     , 8H51.5     , 8H         ,      00002220
     6 8H         , 8H         , 8H         , 8H         , 8H      202,      00002230
     7 8H         , 8H         , 8H         , 8H         , 8H         ,      00002240
     8 8H         , 8H11.1     , 8H10.9     , 8H         , 8H      203,      00002250
     9 8H65.7     , 8H98.55    , 8H0.0      , 8H460.     , 8H0.0      ,      00002260
     A 8H0.5      , 8H-1.8     , 8H3.4      , 8H         , 8H      204,      00002270
     B 8H115.     , 8H69.0     , 8H0.0      , 8H333.5    , 8H0.0      ,      00002280
     C 8H0.5      , 8H-1.85    , 8H3.35     , 8H         , 8H      205,      00002290
     D 8H5.53     , 8H35.0     , 8H.01      , 8H4.27     , 8H40.0     ,      00002300
     E 8H.01      , 8H         , 8H         , 8H         , 8H      206,      00002310
     F 8H93000.   , 8H28300.   , 8H         , 8H0.0      , 8H.03025   ,      00002320
     G 8H-1.56E-2, 8H-6.48E-4, 8H         , 8H         , 8H      207,      00002330
     H 8H-2.0     , 8H3.0      , 8H1.0      , 8H         , 8H         ,      00002340
     I 8H         , 8H         , 8H         , 8H         , 8H      209/      00002350
      DATA V52/                                                              00002360
     1 8H.04      , 8H.5       , 8H1.0      , 8H1.59     , 8H2.21     ,      00002370
     2 8H3.31     , 8H         , 8H         , 8H         , 8H    1 209,      00002380
     3 8H-2.74    , 8H-2.04    , 8H-1.3     , 8H-0.58    , 8H0.14     ,      00002390
     4 8H0.86     , 8H         , 8H         , 8H         , 8H    2 209,      00002400
     5 8H-3.0     , 8H3.0      , 8H3.0      , 8H         , 8H         ,      00002410
     6 8H         , 8H         , 8H         , 8H         , 8H      210,      00002420
     7 8H.09      , 8H0.0      , 8H-0.9     , 8H         , 8H         ,      00002430
     8 8H         , 8H         , 8H         , 8H         , 8H    1 210,      00002440
     9 8H-3.0     , 8H3.0      , 8H3.0      , 8H         , 8H         ,      00002450
     A 8H         , 8H         , 8H         , 8H         , 8H      211,      00002460
     B 8H.20      , 8H.29      , 8H.38      , 8H         , 8H         ,      00002470
     C 8H         , 8H         , 8H         , 8H         , 8H    1 211,      00002480
     D 8H0.0      , 8H7.35     , 8H0.3      , 8H7.35     , 8H1.0      ,      00002490
     E 8H4.13     , 8H         , 8H         , 8H         , 8H      212/      00002500
C                                                                               2510
C 1971 VEGA DATA (VEH. NO. 6) FROM REFERENCE 3                                  2520
C                                                                               2530
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      DATA V61/
     1 8H    1971, 8H VEGA 23, 8H00 SPORT, 8H COUPE  , 8H2-PASSEN,
     2 8HGER LOAD, 8H        , 8H        , 8H        , 8H     200,
     3 8H5.831   , 8H0.424   , 8H0.575   , 8H2000.   , 8H12000.  ,
     4 8H15600.  , 8H-100.   , 8H250.    , 8H        , 8H     201,
     5 8H43.87   , 8H53.13   , 8H55.1    , 8H54.1    , 8H1.31    ,
     6 8H38.0    , 8H        , 8H        , 8H        , 8H     202,
     7 8H        , 8H        , 8H        , 8H        , 8H        ,
     8 8H        , 8H8.58    , 8H7.21    , 8H        , 8H     203,
     9 8H96.0    , 8H        , 8H        , 8H        , 8H        ,
     A 8H        , 8H-2.2    , 8H3.84    , 8H        , 8H     204,
     B 8H121.0   , 8H        , 8H        , 8H        , 8H        ,
     C 8H        , 8H-2.2    , 8H4.85    , 8H        , 8H     205,
     D 8H2.0     , 8H37.0    , 8H0.01    , 8H2.0     , 8H58.0    ,
     E 8H0.01    , 8H        , 8H        , 8H        , 8H     206,
     F 8H0.0     , 8H11690.  , 8H-0.01   , 8H        , 8H        ,
     G 8H        , 8H        , 8H        , 8H        , 8H     207,
     H 8H-4.0    , 8H4.0     , 8H1.0     , 8H        , 8H        ,
     H 8H        , 8H        , 8H        , 8H        , 8H     209/
      DATA V62/
     1 8H-4.75   , 8H-3.08   , 8H-1.75   , 8H-0.73   , 8H0.0     ,
     2 8H0.48    , 8H0.65    , 8H0.78    , 8H0.83    , 8H   1 209/
C********
C          REFERENCES
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C
C  2  SCHURING,D.J.,KUNKEL,D.T.,MASSING,D.E.,ROLAND,R.D.,"THE INFLUENCE
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C  3  DELEYS,N.J. AND SEGAL,D.J., "VEHICLE REDIRECTION EFFECTIVENESS
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C
C********
      END
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      SUBROUTINE FBDTCH(S1,S2,S3,Y1,Y2,Y3,R,B1,B2,DBS)
C******
C         PROGRAM TO COMPUTE AND PUNCH HVOSM V-4 TERRAIN TABLES FOR ROUND
C         FLAT DITCH BOTTOM CROSS SECTIONS
C******
C         INPUTS REQUIRED:
C           S1 = SHOULDER SLOPE
C           S2 = SIDE SLOPE
C           S3 = BACK SLOPE
C           Y1 = LATERAL POSITION OF SHOULDER BREAK (INCHES)
C           Y2 = LATERAL POSITION OF INTERSECTION OF SIDE SLOPE AND FLAT
C               DITCH BOTTOM (INCHES)
C           Y3 = LATERAL POSITION OF INTERSECTION OF FLAT DITCH BOTTOM
C                AND BACK SLOPE (INCHES)
C           R = TANGENT POINT OF SHOULDER ROUNDING FROM SHOULDER BREAK
C               MEASURED ALONG SHOULDER AND SIDE SLOPES (INCHES)
C           B1 = TANGENT POINT OF SIDE SLOPE-DITCH BOTTOM ROUNDING FROM
C                INTERSECTION MEASURED ALONG SLOPE AND BOTTOM (INCHES)
C           B2 = TANGENT POINT OF DITCH BOTTOM-BACK SLOPE ROUNDING FROM
C                INTERSECTION MEASURED ALONG BOTTOM AND SLOPE (INCHES)
C           DBS= LATERAL RUN-OUT DISTANCE OF THE BACK SLOPE (INCHES)
C******
C         OUTPUT:
C           PRINTED AND PUNCHED TERRAIN TABLES INCLUDING HVOSM CARD 14
C           (USER MUST SUPPLY TABLE FRICTION COEFFICIENTS ON THIS CARD).
C           TABLE 1 = SHOULDER
C           TABLE 2 = SHOULDER-SIDE SLOPE ROUNDING
C           TABLE 3 = SIDE SLOPE
C           TABLE 4 = SIDE SLOPE-BOTTOM ROUNDING
C           TABLE 5 = DITCH BOTTOM, BACK SLOPE ROUNDING AND BACK SLOPE
C******
C          NOTE:
C
C          BEGINNING, END AND INCREMENT IN THE X' DIRECTION ARE THE SAME
C          FOR ALL FIVE TERRAIN TABLES AND ARE FIXED AT VALUES OF
C          XB=-500, XE=9500, AND DX=5000.
C
C******
C
C         METHOD:
C           THE THREE ROUNDINGS ARE COMPUTED AS CIRCULAR ARCS BETWEEN
C           TANGENT POINTS AS DETERMINED BY R,B1,AND B2.
C           THE EDGE OF PAVEMENT IS ASSUMED TO LIE ALONG THE X' AXIS
C           AT 0.0 ELEVATION.
C           IF THE ELEVATION DROP AT 10 FT. FROM THE EDGE OF PAVEMENT
C           DUE TO SHOULDER SLOPE AND ROUNDING EXCEEDS 10" THE SIDE SLOPE
C           IS MOVED LATERALLY TO MEET THIS CONSTRAINT.
C******
C         COMPUTATIONAL CONSTRAINTS:
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```
C          THE THREE INPUT SLOPES MUST BE NON-ZERO.
C          THE BACK SLOPE IS ENTERED AS A NEGATIVE QUANTITY.
C          THE DITCH BOTTOM IS ASSUMED HORIZONTAL.
C          0<Y1<Y2<Y3
C          INPUTS MUST BE COMPATIBLE SUCH THAT THE LATERAL POSITION OF T
C          END OF THE SHOULDER ROUNDING IS LESS THAN THE LATERAL POSITIO
C          OF THE BEGINNING OF THE SIDE SLOPE-BOTTOM ROUNDING. IF THIS
C          CONDITION IS NOT MET AN ERROR MESSAGE IS OUTPUT.
C          Y3-Y2>B1+B2
C******
      DIMENSION X(10),Y(30),Z(30)
      IND = 0
    1 Z1 = Y1*S1
      Z2 = Z1+S2*(Y2-Y1)
      Z3 = Z2
      Y4 = Y1-R/SQRT(S1**2+1.)
      Z4 = Z1-S1*(Y1-Y4)
      Y5 = Y1+R/SQRT(S2**2+1.)
      Z5 = Z1+S2*(Y5-Y1)
      YC1 = S1*S2*(Z5-Z4+Y5/S2-Y4/S1)/(S1-S2)
      ZC1 = -YC1/S1+Z4+Y4/S1
      R1 = SQRT((Y4-YC1)**2+(Z4-ZC1)**2)
      WRITE(6,9000) YC1,ZC1,R1
 9000 FORMAT('1',10X,'YC1=',F10.2,10X,'ZC1=',F10.2,'R1=',F10.2)
      IF(IND.EQ.1) GO TO 10
      YY = 120.0
      IF  ((YY.GT.Y5).OR.(S1.GT.0.08333).OR.(YY.LT.Y4))  GO TO 10
      Z1T = ZC1-SQRT(R1**2-(YY-YC1)**2)
      IF(Z1T.LE.10.) GO TO 10
      ZZ = S1*YY
      DEL = 10.-ZZ
      Z1D = ZZ+DEL
      A = S1**2+1.
      D = -2.*(YY+S1**2*YC1-S1*ZC1+Z1D*S1)
      C = (S1*YC1)**2-2.*S1*ZC1*YC1+ZC1**2+2.*Z1D*S1*YC1-2.*Z1D*ZC1
      C = C+ZZ**2+2.*ZZ*DEL+DEL**2+YY**2-R1**2
      YT = (-D-SQRT(D**2-4.*A*C))/(2.*A)
      ZC1 = S1*YT+ZC1-S1*YC1
      YD = YT-YC1
      YC1 = YT
      Y1 = Y1+YD
      Y2 = Y2+YD
      Y3 = Y3+YD
      IND = 1
      WRITE(6,9001) YC1,ZC1,Y1,Y2,Y3
 9001 FORMAT('0','PROFILE MODS. YC1=',F10.2,' ZC1=',F10.2,' Y1=',F10.2,
     1        ' Y2=',F10.2,' Y3=',F10.2 )
      GO TO 1
   10 Y7 = Y2+B1
      Z7 = Z2
      Y6 = Y2-B1/SQRT(S2**2+1.)
```

```
      IF(Y6.GE.Y5) GO TO 569
      WRITE(6,7000)  Y5,Y6
 7000 FORMAT('0      INPUT INCOMPATABILITY  Y6<Y5  STOP' /
     1       10X,'Y5 =',F12.3,10X,'Y6 =',F12.3)
      STOP
  569 Z6 = Z2-S2*(Y2-Y6)
      YC2 = Y7
      R2 = (Y7-Y6)*SQRT(S2**2+1.)/S2
      ZC2 = Z7-R2
      Y8 = Y3-B2
      Z8 = Z3
      Y9 = Y3+B2/SQRT(S3**2+1.)
      Z9 = Z3+S3*(Y9-Y3)
      YC3 = Y8
      R3 = -(Y9-Y8)*SQRT(S3**2+1.)/S3
      ZC3 = Z3-R3
  200 WRITE(6,2001) S1,S2,S3,Y1,Y2,Y3,R,B1,B2,DBS
 2001 FORMAT(' S1=',F8.6,' S2=',F8.6,' S3=',F8.5,' Y1=',F8.2,' Y2=',
     1       F8.2,' Y3=',F8.2,' R=',F8.1,' B1=',F8.2,' B2=',F8.2,'
     2       DBS=',F8.1)
      NC = 500
      DO 100 M=6,7
      WRITE(M,9010) NC
 9010 FORMAT(76X,I4)
  100 CONTINUE
  101 IZ = 1
      ZI = 0.0
      XB = -500.
      XE = 9500.
      DX = 5000.
      YB = 0.
      YE = Y4
      XNB = 0.
      YNB = 0.
      DY = .5*Y4
      N = 3
      Z(1) = 0.
      Z(2) = .5*Z4
      Z(3) = Z4
      NCRD = 1
      DO 1011 I=4,9
 1011 Z(I) = 0.0
      GO TO 900
  102 IZ = 2
      ZI = 0.0
      YB = Y4
      YE = Y5
      N = (YE-YB)/6.+1
      IF(N.GT.21) N=21
      DY = (YE-YB)/(N-1)
      DO 110 I=1,N
```

```
      Y(I) = YB+(I-1)*DY
  110 Z(I) = ZC1-SQRT(R1**2-(Y(I)-YC1)**2)
      NCRD = N/9 + 1
      IF(MOD(N,9).EQ.0) NCRD = NCRD-1
      NF = 9*NCRD
      IF(NF.EQ.N) GO TO 900
      NP1 = N+1
      DO 1101 I=NP1,NF
 1101 Z(I) = 0.0
      GO TO 900
  103 IZ = 3
      ZI = 0.0
      YB = Y5
      YE = Y6
      N = 3
      DY = (YE-YB)/2.
      Z(1) = Z5
      Z(2) = Z5+.5*(Z6-Z5)
      Z(3) = Z6
      NCRD = 1
      DO 1031 I=4,9
 1031 Z(I) = 0.0
      GO TO 900
  104 IZ = 4
      ZI = 0.0
      YB = Y6
      YE = Y7
      N = (YE-YB)/6.+1
      IF(N.GT.21) N = 21
      DY = (YE-YB)/(N-1)
      DO 111 I=1,N
      Y(I) = YB+(I-1)*DY
  111 Z(I) = ZC2+SQRT(R2**2-(Y(I)-YC2)**2)
      NCRD = N/9 + 1
      IF(MOD(N,9).EQ.0) NCRD = NCRD-1
      NF = 9*NCRD
      IF(NF.EQ.N) GO TO 900
      NP1 = N+1
      DO 1041 I=NP1,NF
 1041 Z(I) = 0.0
      GO TO 900
  105 IZ = 5
      ZI = 1.0
      N = 21
      YB = Y7
      DY = (Y9-Y8)/18.
      Z(1) = Z8
      Y(1) = YB
      DO 742 J=1,19
      JJ = J+1
      Y(JJ) = Y8+(J-1)*DY
```

```
  742 Z(JJ) = ZC3+SQRT(R3**2-(Y(JJ)-YC3)**2)
      Y(21) = Y(20)+DBS
      Z(21) = Z(20)+S3*(Y(21)-Y(20))
      YE = Y(21)
      X(1) = XB
      X(2) = XB+DX
      X(3) = XE
      DO 1052 I=4,9
 1052 X(I) = 0.0
      DX = 3.
      DY = 21.
      NCRD = 3
      DO 1051 I=22,27
      Z(I) = 0.0
 1051 Y(I) = 0.0
  900 CONTINUE
      ICRD = 500+IZ
      DO 301 M=6,7
      WRITE(M,1000) XB,XE,DX,YB,YE,DY,XNB,YNB,ZI,ICRD
 1000 FORMAT(9F8.2,4X,I4)
  301 CONTINUE
      ITAB = 0
      DO 901 K=1,3
      DO 902 J=1,NCRD
      ITAB = ITAB+1
      IB = J*9-8
      IE = IB+8
      DO 302 M=6,7
      WRITE(M,1001) (Z(I),I=IB,IE),ITAB,ICRD
  302 CONTINUE
 1001 FORMAT(9F8.2,2I4)
  902 CONTINUE
  901 CONTINUE
      GO TO(102,103,104,105,950),IZ
  950 CONTINUE
      DO 303 M=6,7
      ITB = ITAB
      DO 310 J=1,3
      IB = J*9-8
      IE = IB+8
      ITB = ITB+1
      WRITE(M,1001) (Y(I),I=IB,IE),ITB,ICRD
  310 CONTINUE
      ITB = ITB+1
      WRITE(M,1001) (X(I),I=1,9),ITB,ICRD
      NC = 506
      WRITE(M,9010) NC
  303 CONTINUE
      RETURN
      END
```

```
      SUBROUTINE RBDTCH(S1,S2,S3,Y1,Y2,R,B,DBS)
C******
C        DITCH BOTTOM CROSS SECTIONS
C******
C        INPUTS REQUIRED:
C          S1=SHOULDER SLOPE
C          S2=SIDE SLOPE
C          S3=BACK SLOPE
C          Y1=LATERAL POSITION OF SHOULDER BREAK (INCHES)
C          Y2=LATERAL POSITION OF INTERSECTION OF SIDE AND BACK SLOPES (
C          R=TANGENT POINT OF SHOULDER ROUNDING FROM SHOULDER BREAK
C            MEASURED ALONG SHOULDER AND SIDE SLOPES (INCHES)
C          B=DITCH WIDTH, MEASURED HORIZONTALLY BETWEEN TANGENT POINTS (
C          DBS= LATERAL RUN-OUT DISTANCE OF THE BACK SLOPE (INCHES)
C******
C        OUTPUT:
C          PRINTED AND PUNCHED TERRAIN TABLES INCLUDING HVOSM CARD 14
C          USER MUST SUPPLY TABLE FRICTION COEFFICIENTS ON THIS CARD
C          TABLE 1 = SHOULDER
C          TABLE 2 = SHOULDER-SIDE SLOPE ROUNDING
C          TABLE 3 = SIDE SLOPE
C          TABLE 4 = DITCH BOTTOM ROUNDING
C          TABLE 5 = BACK SLOPE
C******
C         NOTE:
C
C         BEGINNING, END AND INCREMENT IN THE X' DIRECTION ARE THE SAME
C         FOR ALL FIVE TERRAIN TABLES AND ARE FIXED AT VALUES OF
C         XB=-500, XE=9500, AND DX=5000.
C
C******
C
C        METHOD:
C          SHOULDER-SIDE SLOPE ROUNDING IS COMPUTED AS A CIRCULAR ARC BE
C          TANGENT POINTS AS DETERMINED BY R.
C          DITCH BOTTOM IS COMPUTED AS TWO CIRCULAR ARCS AS DETERMINED
C          BY B AND GEOMETRIC SLOPE AND ELEVATION CONSTRAINTS.
C          THE EDGE OF PAVEMENT IS ASSUMED TO LIE ALONG THE X' AXIS
C          AT 0.0 ELEVATION.
C          IF THE ELEVATION DROP AT 10' FROM THE EDGE OF PAVEMENT DUE TO
C          SHOULDER SLOPE AND ROUNDING EXCEEDS 10" THE SIDE SLOPE IS MOV
C          LATERALLY TO MEET THIS CONSTRAINT
C******
C        COMPUTATIONAL CONSTRAINTS:
C          THE THREE INPUT SLOPES MUST BE ENTERED AS NON-ZERO
C          THE BACK SLOPE IS ENTERED AS A NEGATIVE QUANTITY
C          0<Y1<Y2
C          INPUTS MUST BE COMPATIBLE SUCH THAT THE LATERAL POSITION
C          OF THE END OF THE SHOULDER ROUNDING IS LESS THAN THE LATERAL
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```
C          POSITION OF THE BEGINNING OF THE BOTTOM ROUNDING. IF THIS
C          CONDITION IS NOT MET AN ERROR MESSAGE IS OUTPUT.
C******
      DIMENSION X(10),Y(30),Z(30)
      IND = 0
    1 Z1 = Y1*S1
      Z2 = Z1+S2*(Y2-Y1)
      Y3 = Y1-R/SQRT(S1**2+1.)
      Z3 = Z1-R*S1/SQRT(S1**2+1.)
      Y4 = Y1+R/SQRT(S2**2+1.)
      Z4 = Z1+R*S2/SQRT(S2**2+1.)
      YC1 = S1*S2*(Z4-Z3+Y4/S2-Y3/S1)/(S1-S2)
      ZC1 = -YC1/S1+Z3+Y3/S1
      R1 = SQRT((Y3-YC1)**2+(Z3-ZC1)**2)
      WRITE(6,9000)YC1,ZC1,R1
 9000 FORMAT('1',10X,'YC1=',F10.2,10X,'ZC1=',F10.2,10X,'R1=',F10.2)
      IF(IND.EQ.1) GO TO 10
      YY = 120.
      IF  ((YY.GT.Y4).OR.(S1.GT.0.08333).OR.(YY.LT.Y3))  GO TO 10
      Z1T = ZC1-SQRT(R1*R1-(YY-YC1)**2)
      IF(Z1T.LE.10.) GO TO 10
      ZZ = S1*YY
      DEL = 10.-ZZ
      Z1D = ZZ+DEL
      A = S1**2+1.
      D = -2.*(YY+S1**2*YC1-S1*ZC1+Z1D*S1)
      C = (S1*YC1)**2-2.*S1*ZC1*YC1+ZC1**2+2.*Z1D*S1*YC1-2.*Z1D*ZC1
      C = C+ZZ**2+2.*ZZ*DEL+DEL**2+YY**2-R1**2
      YT = (-D-SQRT(D*D-4.*A*C))/(2.*A)
      ZC1 = S1*YT+ZC1-S1*YC1
      YD = YT-YC1
      YC1 = YT
      Y1 = Y1+YD
      Y2 = Y2+YD
      IND = 1
      WRITE(6,9001)YC1,ZC1,Y1,Y2
 9001 FORMAT('0','PROFILE MODS. YC1=',F10.2,10X,'ZC1=',F10.2,10X,
     1        'Y1=',F10.2,10X,'Y2=',F10.2)
      GO TO 1
   10 R2 = .5*B*SQRT(1.+S2**2)/S2
      R3 =-.5*B*SQRT(1.+S3**2)/S3
      A1 = R3/S3-SQRT(R3**2-(.5*B)**2)/S3
      A2 = -R2/S2+SQRT(R2**2-(.5*B)**2)/S2
      Z11 = S2*S3*(B+Z2/S3-Z1/S2+Y1-Y2+A1+A2)/(S2-S3)
      Z9 = Z11-R2
      Z10 = Z11-R3
      Z7 = Z9+SQRT(R2**2-(.5*B)**2)
      Z8 = Z10+SQRT(R3**2-(.5*B)**2)
      Y7 = Y1+(Z7-Z1)/S2
      IF(Y7.GT.Y4) GO TO 569
      WRITE(6,7000)
```

```
7000 FORMAT('0   INPUT INCOMPATIBILITY  Y7<Y4  STOP' )
     STOP
 569 Y8 = Y2+(Z8-Z2)/S3
     Y11 = Y7+B/2.
     YC2 = Y11
     ZC2 = Z9
     YC3 = Y11
     ZC3 = Z10
 200 WRITE(6,2001) S1,S2,S3,Y1,Y2,R,B,DBS
2001 FORMAT(' S1=',F8.6,' S2=',F8.6,' S3=',F8.5,' Y1=',F8.2,' Y2=',
    1       F8.2,' R=',F8.1,' B=',F8.2,' DBS=',F8.1)
     NC = 500
     DO 100 M=6,7
     WRITE(M,9010) NC
9010 FORMAT(76X,I4)
 100 CONTINUE
 101 IZ = 1
     ZI = 0.0
     XB = -500.
     XE = 9500.
     DX = 5000.
     YB = 0.
     YE = Y3
     XNB = 0.
     YNB = 0.
     DY = .5*Y3
     N = 3
     Z(1) = 0.
     Z(2) = .5*Z3
     Z(3) = Z3
     NCRD = 1
     DO 1011 I=4,9
1011 Z(I) = 0.0
     GO TO 900
 102 IZ = 2
     ZI = 0.0
     YB = Y3
     YE = Y4
     N = (YE-YB)/6.+1
     IF(N.GT.21) N=21
     DY = (YE-YB)/(N-1)
     DO 110 I=1,N
     Y(I) = YB+(I-1)*DY
 110 Z(I) = ZC1-SQRT(R1**2-(Y(I)-YC1)**2)
     NCRD = N/9 + 1
     IF(MOD(N,9).EQ.0) NCRD = NCRD-1
     NF = 9*NCRD
     IF(NF.EQ.N) GO TO 900
     NP1 = N+1
     DO 1101 I=NP1,NF
1101 Z(I) = 0.0
```

```
      GO TO 900
  103 IZ = 3
      ZI = 0.0
      YB = Y4
      YE = Y7
      N = 3
      DY = (YE-YB)/2.
      Z(1) = Z4
      Z(2) = Z4+.5*(Z7-Z4)
      Z(3) = Z7
      NCRD = 1
      DO 1031 I=4,9
 1031 Z(I) = 0.0
      GO TO 900
  104 IZ = 4
      ZI = 0.0
      YB = Y7
      YE = Y8
      N = (YE-YB)/6.+1
      IF(N.GT.21) N=21
      DY = (YE-YB)/(N-1)
      DO 111 I=1,N
      Y(I) = YB+(I-1)*DY
      IF(Y(I).GE.Y11) GO TO 112
      Z(I) = ZC2+SQRT(R2**2-(Y(I)-YC2)**2)
      GO TO 111
  112 Z(I) = ZC3+SQRT(R3**2-(Y(I)-YC3)**2)
  111 CONTINUE
      NCRD = N/9 + 1
      IF(MOD(N,9).EQ.0) NCRD = NCRD-1
      NF = 9*NCRD
      IF(NF.EQ.N) GO TO 900
      NP1 = N+1
      DO 1041 I=NP1,NF
 1041 Z(I) = 0.0
      GO TO 900
  105 IZ = 5
      ZI = 1.0
      YB = Y8
      YE = Y8+DBS
      DY = (YE-YB)/2.
      N = 3
      Z(1) = Z8
      Z(2) = Z8+S3*DY
      Z(3) = Z8+2.*S3*DY
      X(1) = XB
      X(2) = XB+DX
      X(3) = XE
      Y(1) = YB
      Y(2) = YB+DY
      Y(3) = YE
```

```
      NCRD = 1
      DO 1052 I=4,9
      Z(I) = 0.0
      Y(I) = 0.0
 1052 X(I) = 0.0
      DX = 3.
      DY = 3.
  900 CONTINUE
      ICRD = 500+IZ
      DO 301 M=6,7
  301 WRITE(M,1000) XB,XE,DX,YB,YE,DY,XNB,YNB,ZI,ICRD
 1000 FORMAT(9F8.2,4X,I4)
      ITAB = 0
      DO 901 K=1,3
      DO 902 J=1,NCRD
      ITAB = ITAB+1
      IB = J*9-8
      IE = IB+8
      DO 302 M=6,7
  302 WRITE(M,1001) (Z(I),I=IB,IE),ITAB,ICRD
 1001 FORMAT(9F8.2,2I4)
  902 CONTINUE
  901 CONTINUE
      GO TO(102,103,104,105,950),IZ
  950 CONTINUE
      ITB1 = ITAB+1
      ITB2 = ITB1+1
      NC = 506
      DO 303 M=6,7
      WRITE(M,1001) (Y(I),I=1,9),ITB1,ICRD
      WRITE(M,1001) (X(I),I=1,9),ITB2,ICRD
  303 WRITE(M,9010) NC
      RETURN
      END
```

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